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QUARTERLY

OF THE

National Fire Protection Association

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87 MILK STREET, BOSTON, MASS.

EDITED BY THE SECRETARY

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West Virginia State Fire Prevention Association.
Wisconsin Inspection Bureau.
Wisconsin State Fire Prevention Association.

Table of Contents.

WHOLESALE GROCERY STORE FIRE..... FRONTISPIECE

EDITORIAL 261

PUBLIC EDUCATION 267

BEFORE AND AFTER 274

UNITED STATES OF DESTRUCTION. *Walter B. Snow*..... 276

STATE FIRE PREVENTION ASSOCIATIONS. COMMITTEE MEETING. 277

CLEANING AUTOMOBILES WITH GASOLENE SPRAY. *Chas. H. Fischer*..... 280

MOTOR PUMPING ENGINES. EFFICIENCY AND HOW TO DETERMINE IT. *George W. Booth* 283

IRON AND STEEL PIPE. RELATIVE CORROSION AS FOUND IN SERVICE. *William H. Walker*..... 288

NATURAL GAS GASOLENE 292

TRANSPORTATION OF NATURAL GAS GASOLENE 296

A COMBINED SPRINKLER AND HEATING SYSTEM. *Gorham Dana*. 300

PAINT FACTORIES. *F. E. Roberts*..... 302

HORSE WHIPS—MANUFACTURING PROCESSES. *John W. Chapman*. 310

PAPER BOX MANUFACTURING. *J. Albert Robinson*..... 328

DEPARTMENT OF FIRE RECORD..... 335

PAPER BOX AND PAPETERIE FACTORIES—FIRE RECORD..... 336

UNSATISFACTORY SPRINKLER FIRES 351

FIRE-RESISTIVE BUILDINGS—FIRE RECORD..... 361

MISCELLANEOUS FIRES 365

FIRE CAUSES..... 374

POINTS OF INTEREST FROM FIRE REPORTS..... 377

STANDARD RULES AND REQUIREMENTS 383

POST OFFICE DEPARTMENT STATEMENT 384

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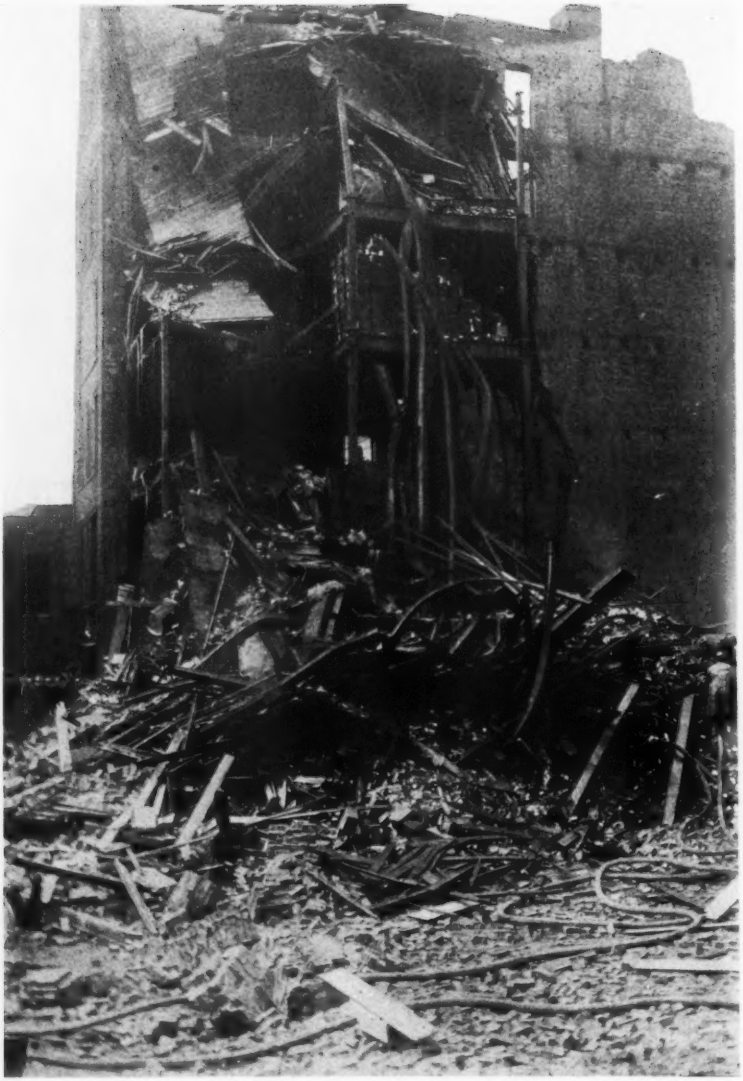

Wholesale Grocery Store Fire.

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The Quarterly

Vol. 6 January, 1913 No. 3

The Outlook. It is difficult for those who have for years been watching the high tide of fire losses in this country to abstain from taking comfort in the fact that the losses for the year just closed were $9,000,000 less than those of the two years 1910 and 1911. It would require a venturous mind, however, to predict that the losses of 1913 will be less than those of 1912. While it is reasonable for us to assume that the total number of fire alarms will be largely reduced in the United States during the year just begun because of the public education now well under way one cannot blink the fact that a single fire may upset all calculations as to totals. So long as so many of our cities still abound in wooden construction, and so long as the window openings in the congested value districts are still largely unprotected, we cannot fail to encounter conflagrations any one of which may run into many millions of dollars. It is natural for the fire prevention engineer to turn to the experienced insurance manager as a barometer, and we have long since contracted the habit of looking at the beginning of each year to our valued New York member Manager Frank Lock of the Atlas Insurance Company for his estimate of conditions and probabilities. Mr. Lock declares at this time that the average rate of premium is steadily declining, so that a much larger load of liability is being carried by the fire insurance companies for the same income, the rate of burning continuing about the same and the expense ratio steadily mounting. Mr. Lock declares that unless the rate of burning takes a sharp turn for the better it is evident that only well managed companies can expect a profitable year, and even these only a very moderate one. Mr. Lock allows, however, that the comparatively favorable conditions as to losses found at the end of 1912 may continue into and through the current year. He hopes that this may be so and that his unfavorable predictions may not prove true.

Boston also. Those who remember the conditions in the city of New York revealed by the Asch Building holocaust, under which the blame for the same could not be fixed and every city department turned to every other city department in an attempt to fix responsibility, will be interested in the remarks of Fire Commissioner Chas. H. Cole of Boston at a meeting of the Twentieth Century Club in that city in December, in which the Commissioner indicates that Boston is at present in exactly as bad a way as was New York before the above mentioned disaster. Mr. Cole said:—

"The authority in Boston is divided among seven different departments, and the fire department has the least of all. A district chief reports an old dilapidated ramshackle building, with falling floors, open doors, windows, and roof as a fire menace to surrounding property. The fire department, which knows best as to whether it is dangerous from a fire standpoint, has no authority, but reports it to the building commissioner. The building department inspects it and condemns it—it is referred to mayor or council; then after a great amount of red tape and months, and sometimes years, it may be ordered razed.

"Again, a chief reports an accumulation of rubbish in a hallway, staircase or cellar. The fire department reports it to the board of health to take the necessary action. A citizen who wishes to get a license to store gasolene does not go to the fire department but to the street commissioners, who have the authority to issue licenses, and are without a force to inspect the premises. A theatre may be so situated that the fire department believes a fire alarm box is necessary on the stage, but we have no authority to oblige them to put one in.

"An old wooden frame building is being used as a garage to the great danger of surrounding property. We have no authority to stop it—we must notify the state police, and they have no men to use for such purposes. A fire escape is blocked with boxes, baskets, etc. The fireman can do nothing; he must notify the city police, who have the sole authority in such matters.

"Is this business? Here is a fire department of one thousand men highly trained and disciplined, more so than any other department, except possibly the Boston police. They have had years of practical experience in all these matters. They have seen fire spread from old dilapidated buildings; they have seen gasolene explode and injure their own comrades. They have seen people burned to death because stairways and fire escapes were blocked. They know what a fire in a theatre or school means, yet with all their knowledge of these conditions, with all their training and all their discipline they are not used.

"Yet every time any attempt is made to change the laws so that these things may be corrected and placed upon a business basis (in the hands of those whose special business it is) a storm of protest is aroused because some few will have to dig into their pockets and spend some of their money. What a spectacle! You and I and every individual must continue to pay a yearly tax twice as large as necessary, and allow our neighbor to be a danger and a menace to our property and our lives.

"No one wants to place unnecessary burdens on business or on the individual, but the good of the whole community should be paramount. Nor can these reforms be brought about in a month or a year. But a campaign started now will work wonders inside of five years, and in ten years will mean a saving of $100,000,000 a year in losses the country over, and our fire departments will cost us less than now to run, notwithstanding the natural growth of our population and wealth.

"Were a law passed like the law they now have in New York, it would put under the fire department, which has a special knowledge of such matters, the different powers now held by the state police, city police, building department, board of health, street commissioners and wire department. It would give the power and

authority to enforce all present laws and ordinances now on the books which are not and cannot be properly enforced to-day, principally through lack of men in the different departments above named; in addition, it gives the department power to require that buildings and places which are inadequately protected against fire be properly protected or else vacated."

* * * * *

Partial Sprinkler Equipments. Members who remember the frequent suggestion made at our annual meetings that the high standard for automatic sprinkler installations, so long upheld by the Association, should be modified to permit the general installation in metropolitan basements of sprinkler pipes and heads, will be interested in notes recently obtained from cities which have encouraged the equipment of school basements with automatic sprinklers.

Following the Collinwood fire and holocaust, cities in the vicinity of Ohio were forced to consider fire protection in connection with their schoolhouses. Cleveland decided to spend its money upon fire escapes, fireproof boiler houses and special exits, although the General Fire Extinguisher Company went so far as to equip the basement of the St. Clair Street School free of cost, and operate impressive illustrative tests thereon. The authorities in the city of Buffalo went somewhat further and equipped the basements of sixty-five of its school buildings with pipes and sprinklers. At the time of these installations the local underwriters were skeptical as to the proper maintenance of these partial equipments, particularly during those periods when the schools were not in session. Subsequent inspections of these properties have confirmed the underwriters' fears in this respect, a considerable number of equipments being found shut off or inoperative, with no satisfactory explanation.

It has always been the feeling of the engineers of our Association, founded sometimes on bitter experience, that a sprinkler system may represent false security where it is not kept under rigid inspection. While undoubtedly it would be an immense gain if all basements in the congested districts were equipped with automatic sprinklers, the full value of such protection could not be secured without rigid inspection continuously maintained.

* * * * *

Replacing Sprinkler Heads. Even in the best appointed establishments sprinkler equipments are frequently found out of order by inspectors. Repairs following a fire or injury of any sort to the system should always be carefully made. It is desirable as a general proposition that sprinkler work of every sort should be installed by the regular sprinkler companies having pride in the proper operation of the equipment. It is obvious, however, that this practice cannot always be followed, as for example—in the event of a fire which opens a small number of sprinklers or some accident occurring which makes it necessary to install a few new sprinkler heads. Prompt action should invariably be taken in restoring the equipment to commission, and in such

an emergency sprinklers must often be installed by the employees of the mill or factory. Work of this character should be done with the greatest care and attention to the details of the installation. Examination of sprinkler heads removed for test purposes has shown heads in which the water passage was entirely obstructed by white lead which had hardened in the same. Investigation of such cases usually demonstrates that such heads were installed by local workmen who evidently handled the same carelessly, possibly even dipping them in the white lead.

In replacing sprinkler heads it is especially essential that a good joint grease be used, several reliable makes of which are on the market. White lead should never be used and the sprinkler head should never be "dipped" in applying the joint grease. The latter should be applied with a small brush to the threads on the sprinkler heads. It is a good plan for each property equipped with an automatic sprinkler system to keep on hand a can of good joint grease with a small brush to be closeted with the supply of extra sprinklers and the special sprinkler wrench to be used in case of emergency. It is always desirable to have the several implements and articles which one is liable to use at the same time in close proximity to one another.

* * * * *

Stovepipes through Partitions. We have a letter from our Chicago member, Mr. A. D. Brooks, Supervisor of Fire Protection of the Illinois Central Railroad, referring to the Association's bulletin on Chimneys and Flues, with special reference to the use of the ventilated thimble recommended for stovepipes passing through a lath and plaster partition. Mr. Brooks advises that the experience of his company with these ventilated thimbles is exceedingly unsatisfactory. He finds that soot gathers on the bottom of any horizontal stovepipe, and during damp weather when there is no fire in the same the soot becomes moist, forming an acid or creosote composition which eats its way through the stovepipe and ventilated thimble, allowing when the fire is rekindled sparks from the burning soot to drop between the partition walls, causing fire. After several experiences of this character, Supervisor Brooks made a thorough examination of all the properties under his direction and caused the removal of every ventilated thimble on the Illinois Central system,—about 3,000 in all. To this improvement a reduced fire loss in station buildings of fifty per cent is credited.

In place of the ventilated thimble the Supervisor counsels the installation of a solid concrete section about eighteen inches square, depending on the spacing of the studs, fitted into the partition, in the center of which the iron thimble is set in the concrete, leaving a one-quarter inch space between the stovepipe and the thimble which, in this case, does not need to be ventilated. The concrete section is supported upon wood blocking fitted under the same and nailed to the enclosing studs.

There is probably no more common use of the stovepipe through

partitions than in railroad practice, and the counsel of Supervisor Brooks is manifestly the result of adequate experience.

* * * * *

Spontaneous Combustion of Charcoal. In 1911 there were sixty-four reported fires in the transportation of charcoal in the United States, and of these sixty-three were evidently caused by spontaneous combustion. During 1911 experiments on the spontaneous heating and ignition of hard wood charcoal were started at Straight, Pa., and at Westline, Pa., by our active member the Bureau for the Safe Transportation of Explosives. The charcoal, after varying treatment as to cooling and air exposure, was loaded into box cars, and the temperature of the interior of these cars was observed at intervals to detect any increase in temperature. From the incomplete series of experiments performed, it was reported (Bureau of Explosives, Report No. 5, February, 1912, p. 47) that "no conclusions can be drawn as to the relative efficiency of various periods of cooling and airing. In no case was there any ignition of an increase of temperature approaching ignition. In every case but one there was a noticeable rise of temperature, which can be ascribed only to the action of air on the cold charcoal and not to any residual sparks or fire." The figures obtained so far have not shown that wetting the charcoal increases the heating effects, although it is the general belief that heating more frequently occurs in damp weather. "To attain absolute security from fires of spontaneous origin it is necessary to store the charcoal in the open till such time as it attains its equilibrium with regard to absorption of air"—an impracticable procedure, so "the logical alternative is to supplement the best present practice of cooling, airing and storing in open cars for twenty-four hours prior to shipment by a safe method of ventilation of cars during shipment."

The experiments on the spontaneous combustion of charcoal recently published by the National Physical Laboratory (Report for 1910, 85; 1911, 86) were conducted in an electrically heated oven, in which 1 cu. ft. of the charcoal was exposed to a uniform temperature (constant within 1° C.), measured by means of thermocouples. The charcoal was surrounded by an air space about 3 inches wide, and the oven could be closed air-tight or a current of air of any desired velocity passed through it. Experiments with flake charcoal showed that with air currents ranging from 5-62 cu. ft. per minute for 1 cu. ft. of charcoal, spontaneous combustion occurred at temperatures of from 96-110° C., while at lower temperatures no signs of spontaneous heating could be observed. Additional experiments showed that in a current of air containing 5 per cent sulphur dioxide, spontaneous combustion of the charcoal took place after some hours; therefore, there is risk of danger in using sulphur dioxide for disinfecting rooms, etc., where charcoal is present in the walls. It is reported that decayed wood appears to be much less inflammable than charcoal.

An Explosive Fire Alarm Box. Fire alarm box 561 at Springfield, Mass., has attained fame, and will now be regarded as the most precocious little iron box in the city. A citizen was walking down King Street one day last week with an unlighted pipe in his mouth. He desired to light up and looked around for something on which to strike his match. Nothing was in sight until he passed a little rusty red iron box hanging on a pole at the corner of King and Hancock Streets. He reached up, struck the match, and box 561, resenting the familiarity, promptly went off with a loud bang. The man with the pipe ducked as the little iron door of the box whiffed by his head at a distance of one-sixteenth of an inch and slammed itself against a fence, breaking three pickets. The fire whistle and bells began to sound forth an alarm. The inside of the box was black and smoking when the fire department got there and began looking for the fire. An investigation revealed the fact that the wires to the alarm box are carried through a conduit in the same tunnel with a leaky gas main, and gas had passed up a pipe into the tightly-shut box for days and days. The man with the pipe disappeared down the street in a dense cloud of heel dust, when some one suggested that he tell his name and address.

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Women Fire Fighters. As an offset to the Suffragettes who have been turning in false fire alarms so peskily in London, a village of New York State can boast a fire brigade of women. Fairview Heights is a suburb of Poughkeepsie, and has already a volunteer fire department, made up of the male portion of the population. As, however, a large number of these are engaged in business either in Poughkeepsie or elsewhere during the day and cannot be on hand if a local fire breaks out during the day, their wives, sisters, daughters and sweethearts have enrolled themselves into an auxiliary fire department, and are being trained to fight fires. They are being regularly drilled and taught how to handle the apparatus. A test of their capacity was given the other day. An alarm was sounded suddenly and unexpectedly, and the ladies hurried to the fire house and in a few minutes had the apparatus on the scene of the blaze, which was a big bonfire built in the middle of the main street. The chemical engine was at once set to work and the fire was quickly extinguished.

Public Education.

The notable event in the Association work in public education during the past quarter was the campaign of our active member the Canadian Manufacturers' Association in the principal cities in Canada during the week of December 16th. Dinners were arranged by the manufacturers in Montreal, Toronto, Hamilton and London, to which city officials, chiefs of fire departments and others interested were invited. It was stated by a high official of the Manufacturers' Association that no work undertaken by that body had made so profound an impression upon the Dominion in so brief a period. Secretary Franklin H. Wentworth was the speaker at each meeting and his efforts met with enthusiastic response from his auditors. The meetings at Montreal and Toronto were of course the most effective, these cities being the largest in the Dominion. Following the remarks of the speaker at the banquet in Montreal, held at the Canada Club, it was unanimously voted to direct the council of the Manufacturers' Association to form a sub-committee to act with other bodies in the city for the purpose of establishing a committee to secure public action in the direction of the prevention of fire waste.

In Toronto, the headquarters of the Association, nearly three hundred of the city's most prominent citizens attended the dinner in spite of holiday influences, and it was voted to at once take steps to secure a satisfactory fire marshal law for the Province and organize local committees to secure the improvements suggested by Secretary Wentworth. The enthusiasm provoked by these meetings is reflected in the following editorial from the *Toronto Globe*, Friday, December 20th, the morning following the meeting:

Incalculable benefit may result to the city of Toronto from the address on fire prevention delivered last night under the auspices of the Canadian Manufacturers' Association by Mr. Franklin H. Wentworth, of Boston. If the result is inadequate the responsibility must rest on the citizens, and not on the speaker. Mr. Wentworth is in the fullest sense of the expression master of his subject, and an artist in handling it. Without detracting in the slightest degree from the instructiveness of his facts, the cogency of his reasoning, or the force of his appeals, he illuminated his address with a quaint New England humor that kept his audience of business men in a state of perennial enjoyment, and thus relieved the didactic character of his speech from the tedium of the commonplace. Never before has such an address been given in Toronto. Its scope was absolutely unprecedented, and the arguments were convincing.

Two practical suggestions, quite within the capacity of any urban centre to carry out, are peculiarly worthy of consideration by the citizens, and just now by the electors, of Toronto. One is the limitation of the height of buildings; the other is

the conversion of the individual firemen into fire inspectors of neighboring buildings when they have time to spare,—for what has been found elsewhere a pleasant and recreative task. In Boston the height of buildings is limited to a hundred and twenty-five feet, and in Montreal it is very little more.

From the profound impression created by Mr. Wentworth's practical address, and the assurances given by the members of the Manufacturers' Association, who briefly supplemented it, there is great likelihood of the early formation of a fire-prevention organization of some kind. It is all important at present to secure that in this matter the new City Council shall be thoroughly seized of the idea that prevention is practicable as well as desirable; otherwise precious time will be lost without any justification in necessity.

The public interest and signal success of this campaign of the Canadian Manufacturers was largely due to the indefatigable energy and tactful management of Mr. E. P. Heaton of Toronto, a member of our Executive Committee and manager of the Insurance Department of the Canadian Manufacturers' Association. It is obvious that this campaign is merely a beginning of our work in the Dominion and that it means a large access in membership which will bring closer association and team work with our present Canadian members. Canadian public life is not so complex as that in the United States, and a policy of fire prevention once undertaken exceedingly rapid progress in preventive measures is certain to be the result.

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In addition to the regular executive work of the office and the above-mentioned campaign in Canada, Secretary Wentworth has made a considerable number of speeches on the fire waste during the quarter. In October he went to Chicago to assist in the observance of Fire Prevention Day in that city, speaking at the noon-day luncheon of the Chicago Association of Commerce in the Hotel La Salle and in the afternoon of the same day at a special meeting of the Chicago Woman's Club. On October 24th he visited Cleveland, O., to address the annual convention of the National Implement and Vehicle Association. On October 28th he spoke at a special meeting of the Business Men's Association of New London, Conn., and on the following evening was the guest and speaker of the Connecticut Association of Local Fire Insurance Agents at their annual banquet at Bridgeport, Conn. On November 13th he visited Norfolk, Va., to speak at a noon meeting of the Norfolk Credit Men, and on November 18th addressed the Rotary Club of Harrisburg, Pa., which had arranged a special evening meeting on fire prevention. On November 21st he spoke at the annual convention of the National Founders' Association at Hotel Astor, New York City. On December 2nd he addressed the Business Men's Association of Pawtucket, and on December 10th delivered an address in Washington, D. C., at the annual convention of our active member the American Institute of Architects. This was the first occasion on which the Institute had made a special topic of fire prevention, and the speaker was listened to with an interest and enthusiasm which promises much from the fraternity of architects in the future.

Mr. W. E. Findlay, one of our Montreal members, spoke on fire prevention at the luncheon of the Montreal Electrical Association on October 3d, and pointed out to the electrical fraternity their obligations to assist in the reduction of the fire waste.

* * * * *

Our Philadelphia member, Mr. Powell Evans, addressed the Central New York Chapter of the American Institute of Architects on the subject of fire prevention at the Technology Club, Syracuse, N. Y., the evening of October 3d. Mr. Evans impressed upon the architects the necessity of paying more attention to the study of fire prevention. Acting on the suggestion, the chapter adopted a resolution recommending the appointment of a committee to co-operate with committees of the Chapters of New York City and Buffalo in a thorough investigation of the fire prevention problems.

* * * * *

Our member, Commissioner Willard Done of Utah, delivered a fine address on the fire waste in the United States before the Conservation Congress at Minneapolis on November 20th. Mr. Done gave especial attention to the "involuntary incendiary" who is responsible for so large a proportion of the fire waste.

* * * * *

Our Jersey City member, Mr. Ernest S. Clayton, delivered an instructive and interesting lecture on the chemistry of fire, with accompanying demonstrations, at the November meeting of the Insurance Library Association of New York City. Mr. Clayton's illustrations were exceedingly interesting, the concluding experiment being one to illustrate the character of the familiar dust explosion. The attendance at this meeting was so large that numbers were unable to gain admittance.

* * * * *

Our New York member, Mr. Frederick C. Mott, addressed the Barebones' Club of New York on the evening of December 3d on the subject "Fire Protection,—The Owner's Viewpoint." Mr. Mott's profession of fire protection engineer admirably equips him to present the thought of the building owners on fire protection.

* * * * *

Former president, William H. Merrill, was the guest of the Sons of Jove at their luncheon held in the Hotel Imperial, New York, on December 4th. Mr. Merrill spoke on "The Basis for General Co-operation," making a plea for a better understanding of one another among electrical inspectors, electrical jobbers and manufacturers and purveyors of electric light and power. On November 9th at a meeting of the Electrical Jobbers' and Manufacturers' Association held at Hot Springs, Va., Mr. Merrill had presented this same question. He urged the need of

uniform rules and practices in various sections of the country in place of the non-uniformity now in existence and the lax enforcement of the code in many districts. Mr. Merrill deplored the fact that the national electrical code, although universally adopted, was by no means followed as it ought to be, particularly in the smaller places and outlying communities where insufficient inspection was a temptation to constractors to use substandard materials. Mr. Merrill's remarks were enthusiastically received, both at Hot Springs and at the New York meeting above referred to.

* * * * *

That other members of the Association realize the necessity for the co-operation pleaded for by Mr. Merrill in matters of electrical installations is indicated by a movement developed in Philadelphia by our member Mr. Washington Devereux.

Beginning with bi-monthly meetings of the inspectors of the Philadelphia Fire Underwriters' Association, initiated several years ago, an informal co-operative movement is making considerable headway in Philadelphia under the guidance of Mr. Devereux, who is chief of the electrical department of the Underwriters' Association.

A few months ago the inspectors and district managers of the Philadelphia Electric Company were invited to attend the association meetings. Invitations were also extended to city inspectors, electrical contractors and their superintendents and foremen. All are now meeting together twice a month to discuss the code, city regulations, the best methods of co-operation between various branches of the industry and how they can most effectively join in plans for increasing business. A question box is provided, and subjects thus brought up are passed upon by a sub-committee, whose reports are regularly presented at the meetings. One result of these electrical conferences is a marked improvement in methods of installation, due to a better understanding not only of the requirements of the code but also of the reasons for the various rules.

* * * * *

Chief Howard L. Stanton of Norwich, Conn., a member of our Committee on Standard Hose Couplings, appeared twice as a speaker during the quarter. He addressed the United Workers of Norwich, on November 12th, giving them plain and helpful advice as to their responsibility in the event of fire. On December 19th he was the guest of the Underwriters' Association of Norwich at a social evening, at which he also spoke on the subject of fire prevention.

* * * * *

Mr. H. C. Henley of St. Louis, a member of our Executive Committee, addressed the City Club at its monthly meeting in November on the subject of fire prevention and fire protection. Mr. Henley reviewed the

progress that has been made by the states in the direction of model fire marshal laws, and indicated the necessity for investigations of all fires in order to discourage the incendiary and teach the masses better housekeeping.

* * * * *

Mr. F. M. Griswold, chairman of our Committee on Standard Hose Couplings, addressed the members of the Fire Insurance Club of Memphis in December and praised the city of Memphis for the improvements it has made in fire protection; also pointing out remaining conspicuous defects. The Fire Insurance Club of Memphis has given much careful attention to the problem of the fire waste.

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Mr. J. Albert Robinson, Superintendent of Fire Records of the N. F. P. A., spoke before the New England Railroad Club at its monthly dinner held December 10th at the American House in Boston. Mr. Robinson pointed out the fact that all the principal railroads of the country were represented in our membership and were co-operating with us in every way possible to reduce the fire waste.

* * * * *

Mrs. P. P. Tucker of Dallas, Texas, chairman of the Fire Prevention Committee of the Dallas Federation of Women's Clubs, has recently issued a form letter to every woman's club in America, calling attention to the proportions of the fire waste, and enclosing a model placard containing pledges for the safety of the home, designed to be hung conspicuously in the kitchen, laundry and fire room of residences. This is the first comprehensive attempt to bring the subject of fire prevention before the members of the women's clubs. Mrs. Tucker is the wife of our valued Texas member Mr. P. P. Tucker, well known in fire insurance circles in that state.

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Since the visit of Secretary Wentworth to the Pacific Coast last year there has been considerable activity in fire prevention work among the local Credit Men. No branch of this important active member has been more zealous in this work than the local association in Portland, Ore., due principally to the energy of the Fire Prevention Committee, of which Mr. E. M. Underwood is chairman. The newspapers in Portland are kept hot with fire prevention news, and Fire Prevention Day was formally established on October 19th. Before asking the Governor to proclaim a Fire Prevention Day the Committee wrote to each of the 171 state commercial clubs, asking their attitude, every response being favorable. The Committee declares that the establishment of this day will result in the

prevention of hundreds of fires, keep the people more alert in fire prevention and eliminate waste and disorder that will save to the people of the state hundreds of thousands of dollars. The week before October 19th the Committee sent out daily bulletins inviting the interest and support of the people to this important matter and telling why they should respond. Chairman Underwood prepared a special lecture with stereopticon views showing spots in the city of Portland where clean-up squads would find work to do. This effective campaign in Oregon is the result of the energy of this indefatigable Committee of the Credit Men.

* * * * *

The Union National Bank, Louisville, Ky., the only bank in the South that is a member of the N. F. P. A., turned its monthly trade letter for December into a fire waste number, giving statistics, the economic penalties and the reasons for our abnormal fire waste. The letter concluded with recommendations for individual care, and the last page was devoted to the holiday warnings issued by our Association in its special Holiday Bulletin. This is undoubtedly the first occasion upon which a bank has brought before its customers the important matter of the fire waste.

* * * * *

Our active member, The American Institute of Architects, has created a committee on public information, the object of which will be to bring before the public the aims and achievements of the Institute in the direction of right practices and proper architecture. The Institute has made chairman of this committee Mr. D. Knickerbacker Boyd of Philadelphia, who combines excellencies as an architect with a fine executive ability. Mr. Boyd's committee will unquestionably be heard from during the coming year. The Institute is to abandon its quarterly magazine and will publish a monthly journal. Mr. R. Clipston Sturgis, our Boston member who has given much attention to the fire waste, is now first vice president of the Institute.

* * * * *

Our active member, The National Association of Credit Men, is still giving considerable space in its valuable monthly bulletin to fire prevention matters. Its December issue contains an article showing the celebrations of Fire Prevention Day in the various cities of the Union, also several articles on the general subject.

* * * * *

Our associate member, The American School of Correspondence, has for over a year been compiling a four volume cyclopedia under the title "Fire Prevention and Insurance." Volume 1 covers fire losses, fireproof construction and building code; volume 2 embraces combustion, underwriters' regulations and fire protection; volume 3 comprises reports, inspections, hazards and underwriting, while volume 4 deals with ratings,

policy and law, and adjusting. Members of the N. F. P. A. have contributed liberally to the compilation of this excellent cyclopedia, among others the following well-known names appearing: F. W. Fitzpatrick, Edward R. Hardy, Dana Pierce, A. H. Nuckolls, J. Albert Robinson, and A. F. Dean. The cyclopedia is a very helpful work to those interested in the subjects treated. It is one of the notable contributions to fire prevention literature that have appeared during the year.

* * * * *

The Association issued its usual Holiday Fire Bulletin well in advance of Christmas week and the members purchased the same in large quantities for distribution in their special localities. Many associate members made liberal use of the same. The State Insurance Board of Austin, Texas, distributed 1,200 copies to the newspapers of that state. The Holiday Bulletin seems to be growing in popularity, more than twice as many copies being printed for the current holidays than at any previous season.

* * * * *

Our Boston member, Mr. Chas. E. Worthington, addressed a special meeting of the Twentieth Century Club of Boston on the subject of the fire waste in December. Mr. Worthington paid especial attention to conditions in Boston, following remarks of Fire Commissioner Chas. H. Cole. Among other things Mr. Worthington said:—

> We have all the material needed and in growing abundance to originate in Boston a gigantic conflagration that would sweep our business centre with irresistible force. The present Boston, in fact, does not favorably compare with Chicago as it was at the time of the great fire. Boston leads all American cities of its class in the number of fires *per capita*, in the relative number of fires extending beyond the building of origin, and in the amount of fire loss *per capita*. The fire limits need to be considerably extended. There should be absolute prohibition of shingle roofs anywhere within the city limits. We need also a revision of the building laws.

* * * * *

Another contribution to the year's output of fire prevention literature is "Fire Prevention," a book by our New York member ex-Chief Edward F. Croker, profusely illustrated and attractively issued by Dodd, Mead & Co.

Before and After.

Being verses written by a policyholder to Mr. Frank P. Tucker while secretary of a fire insurance company.

Before.

November 20th.

DEAR FRANK:—

I got your letter but I don't know what you mean
By sendin' me them notices to keep my chimneys clean.
There ain't no special danger as they are and, anyhow,
I'm too eternal busy fer to bother with 'em now.
You insurance men is funny, fer you recollect, no doubt,
How you kept a-dingin' at me till I made the papers out:
How you kept a-howlin' "Fire" till I said that I'd be blest
If I didn't get a policy jest so you'd let me rest.

But when I took the papers, Frank, that didn't seem to suit you,
And you kept a-howlin' "Fire" till I've half a mind to shoot you.
An' all the while I'm gettin' bills an' circulars unendin'
That's warnin' me about the awful danger that's impendin'.
An' when you get this letter, an' you see what it's about,
I half expect you'll telegraph me: "Clean your stovepipe out."
Now, Tucker, I've forgiven you fer all your former zest,
But when you get a man insured, why can't you let him rest?

Calamity's your hobby an' I s'pose you've got to sputter,
'Cause that's what you're relyin' on to get yer bread an' butter.
Ye're a skittish lot o' skeptics an' you'd all start in a-cryin'
If a feller got religion, 'cause you'd think that he wuz dyin'.
Ye're a pessimistic outfit fer ye're all Miss fortune's debtors,
But Y'aint alarmin' me at all by all them skeery letters.
Yer policies is good an' they has always met the test,
But yer something of a nuisance, so please let the matter rest.

I mean it, Frank, fer while yer rates is only jest a fraction
Of what the trust is chargin' I can't get no satisfaction.
Fer Liz, my wife, she reads yer stuff, an' then won't let me sleep
Until she makes me promise to become a chimney sweep.
I'll hev to clean 'em sometime but ye needn't get too skeery
Or scold because a hard-worked man like me is sometimes weary.
I'll clean 'em when I'm ready to, an' that's about the best
I will do.

Yours sincerely,

ZEKE.

P. S.—I want to rest.

After.

December 9th.

DEAR FRANK:—

I'm feelin' better an' my head ain't quite so sore,
An' Doc. he says I'll be around in about a month or more.
My ankle's sprained fer fair an' there's a splinter in my hoof,
An' I also hurt my back a-jumpin' off the kitchen roof.

It happened all so sudden like I couldn't stop to plan
An' I jumped astride a sawbuck which is tough on any man.
But when the house is burnin' an' yer jest about to choke
You've got to move some rapid, fer a fire 'aint no joke.

I'm glad the wife an' all the girls wuz sleepin' down below,
But I sorter hate to mention 'em—it makes me shudder so.
They all got out alive an' well, although you know—the flames
Took everything they owned except their nightshirts and their names.
I tell you, Frankie, I wuz wise to have my place insured
For a family ungarmented ain't long to be endured.
If twuzn't fer my foresight, Frank, we'd now be worse than broke,
A homeless, helpless, hopeless crowd, which wouldn't be no joke.

I couldn't say exactly, Frank, jest how the blaze occurred;
What happened first is hard to tell from what wuz next, an' third.
I heard the chimney roarin' an' smelt the paint a-fryin'
An' I axed myself the question, "Am I livin', Zeke, or dyin'?"
I can't recall the num'rous things I must hev thunk an' sed,
But decided I wuz livin' and a-jumpin' from my bed.
My ears wuz full o' noises an' the room wuz full o' smoke,
An' my thoughts wuz full o' **gittin' out,** fer fires ain't no joke.

You know I'm philosophical ez anyone kin be,
But Lizzie (that's my wife, you know) is raisin' cain with me.
She's cranky some an' allus finds a thing to nag about;
Gest now it's cause I didn't get to clean the chimney out;
She sez that most the fires now to sech neglect is traced
An' cries because she's lost so much that cannot be replaced.
Did you ever hev a household full o' naggin' women folk
Accusin' you of crool neglect? Well, Frank, it ain't no joke.

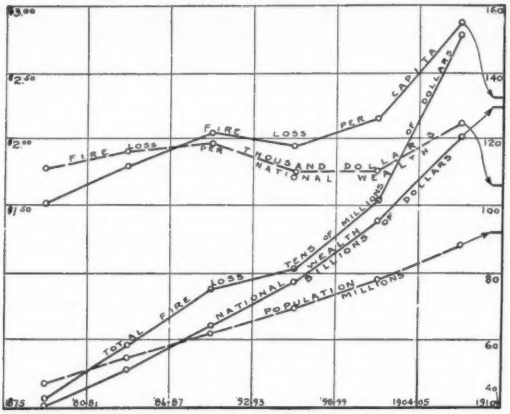
I b'lieve you writ me sev'ral times 'bout cleanin' out the flues
But I want to ask you candid-like: what is yer honest views?
Of course a feller hates to up an' call his wife a liar,
But do you 'spose my small neglect could be what caused that fire?
I kept a-puttin' of it off, fer I wuz awful busy,
But all excuses of the kind don't cut no ice with Lizzie.
She sez that in the future she won't let no lazy bloke
Put her an' hers in peril, fer a fire ain't no joke.

She needn't worry, Frank, fer under sim'lar circumstances,
In the future I ain't likely fer to take no desprit chances,
I couldn't keep from thinkin' (an' the thoughts they sort o' rankle)
That acute procrastination is the trouble with my ankle.
I realize my error fer it wouldn't hev been funny
If you'd procrastinated in a-sendin' me the money.
I'm startin' new an' better now (remember what I've spoke)
I'm learnin'.

Yours sincerely,

ZEKE.

P. S.—This ain't no joke.



Population, National Wealth and Fire Losses

The United States of Destruction.

By Walter B. Snow (Member N. F. P. A.).

The chart shows the progress historically of fire losses (buildings and contents) in the United States during the past thirty-six years. In order to smooth over inequalities due to extreme losses one year and considerably lower ones the next, the chart has been figured out on the basis of averages for six years, and is so plotted. There are five curves presented, of which the one depicting the total fire loss, in tens of millions of dollars, shows the greatest rate of increase at practically every point across the chart. It is growing faster than the national wealth, and very much faster than the population. Both of these facts are seen in the upper curves showing, respectively, the fire loss per capita and the fire loss per thousand dollars of national wealth, each of which is now well above the two-dollar mark.

During the thirty-six years covered by the chart, the fire loss in the United States has amounted to the stupendous figure of $5,120,622,540. This is more than 7 per cent on the average value of national wealth over this period of time. As a matter of fact, the present annual gain in wealth, which is about $4,600,000,000, represents only the capital at 5 per cent, of our annual fire loss of $230,000,000 per year.

The increase in population between the six-year period 1875 to 1880, inclusive, and the period 1905 to 1910 inclusive, was about 90 per cent. During this same period the national wealth increased approximately 200 per cent, and the corresponding wealth per capita gained nearly 60 per cent. In this same period the total fire loss of the country increased more than 240 per cent and the fire loss per capita very nearly doubled. All of these facts are shown on the chart.

Committee on State Fire Prevention Associations.

Meeting at Cincinnati, O., November 27th.

A meeting of the Committee on State Fire Prevention Associations was held at the Hotel Sinton in Cincinnati on November 27th, Chairman J. P. Hubble of Louisville presiding. The following were in attendance: John L. Sowards, J. M. Neuburger, William Sowards and George W. Cleveland of Cincinnati; R. F. Woltersdorf of Illinois; W. E. Page of Iowa; Clark O. Wood of Ohio; George R. Crosley of Wisconsin; F. G. Snyder, F. M. Drake and H. Lee Upton of Kentucky; C. B. Roulet of Texas; A. L. De Rosset of North Carolina and Franklin H. Wentworth of Boston, Secretary of the N. F. P. A. Captain J. J. Conway of the Cincinnati Salvage Corps was present as a guest.

Although this committee has been in existence for more than two years, a formal meeting of the same had never before been called. It developed at the meeting that the inactivity of the committee had been due almost entirely to a lack of complete understanding on the part of the members as to what the duties and prerogatives of the committee were.

The Committees of the N. F. P. A. are almost wholly autonomous. The parent body does not dictate nor direct the committee work once the scope of the latter is clearly understood. The Committee on State Fire Prevention Associations was appointed in the regular manner, the members made up of representatives from the various state associations. The object of the appointment of the committee was to provide a central head and clearing house under the direction of the state associations themselves, which might serve as a central organization (although a department of the N. F. P. A.), to keep the state associations in touch with one another and their work, and to aid in the development and establishment of the state association idea. Previous to the appointment of Mr. John P. Hubble as chairman of this committee no meetings of the same had been called for the purpose of outlining the nature of the work, and the state associations, not understanding the autonomous character of their committee, somehow got the erroneous impression that the N. F. P. A was not interested in the committee and by leaving it to itself was neglecting it.

In order that this misunderstanding might be cleared up, Chairman Hubble invited Secretary Wentworth to attend the Cincinnati meeting for the purpose of conference and the elimination of all misconceptions.

Although but a limited number of committee members were present the meeting was an enthusiastic one, and all concerned felt well repaid for attending it. Emphasis was laid upon the necessity for co-operation and

uniformity in the promulgation of state laws and ordinances, building codes and the like, considerable confusion having resulted from conflicting measures passed by the different states. The state associations are henceforth to urge the adoption of only such laws and ordinances as have been agreed upon and adopted by the N. F. P. A., in conjunction with the National Board of Fire Underwriters.

An important action on the part of the meeting was the appointment of Mr. Frank M. Drake, of Louisville, as a member of the Committee on Laws and Ordinances. Mr. Drake was subsequently made a member of the Committee on Laws and Ordinances of the N. F. P. A., of which Mr. Chas. H. Lum, of New York, is Chairman, and subsequently attended the meeting of this committee in New York City December 3d and 4th.

Mr. J. M. Neuburger, of Cincinnati, was elected permanent secretary of the State Associations' Committee, and Secretary Wentworth, of the N. F. P. A., reported an appropriation of $250 for the current association year, which had been placed at the disposal of the committee for the prosecution of its work.

After the formal business for which the meeting had been called was disposed of, a general discussion was held by those present as to methods of work.

Chairman Hubble made two concrete recommendations in favor of the appointment of two sub-committees, after having gone over the matter with Secretary Wentworth. The first resulted in the appointment of Mr. Drake on the Committee on Laws and Ordinances, the second in a Committee on Publicity and Program. He said that the state associations could do great work in publicity and education and in the crystallization of public sentiment into law, and should be regarded as the right hand of the department of publicity and education of the N. F. P. A. "Heretofore," he said, "insurance men have said to the public, you make the condition and we will make the rate." He characterized this as a barbarous and obsolete point of view, and that the insurance men should feel a responsibility in helping to improve conditions. The members of the state associations, being in touch with local conditions, can furnish many suggestions and give much help to the N. F. P. A. in dealing with fire waste questions, and they will be given a greater opportunity to do this than heretofore.

One of the interesting questions that came up in regard to legislation was whether it is the best policy to adopt ordinances singly or in whole as a code. Mr. Hubble decidedly preferred the latter.

Secretary Wentworth, in his talk, defined the attitude of the N. F. P. A. to the state associations. He said that the committee was appointed to avoid as far as possible a duplication of effort. The committee was to be wholly autonomous, and the N. F. P. A. from a feeling of delicacy and with a desire not to appear dictatorial had kept its hands off, while some of the members of the state associations thought the N. F. P. A. was neglecting them.

The N. F. P. A. considered the state associations committee in the same light as any of its other committees, looking for the usual reports from

it at the annual meeting. It desires above all co-operation, and Mr. Wentworth believed that the meeting would have the good result of establishing the proper basis for that co-operation. He said that the associations are the very channels through which to handle publicity and educational work. In the matter of providing standards for ordinances, etc., he pointed out the necessity for having this work done by the national body, and said that the national committee in framing its ordinances took into consideration the big trade interests, in order, where possible, to neutralize their hostility to such measures. As to suggestions for plans, for local meetings, etc., he had none to offer, as he felt that was purely within the scope of the local associations.

He said that this is an era of investigation in every direction, that people are insisting on knowing how rates are made and all about the workings of the rating schedules, and that the companies should not and do not have any objection to this knowledge being disseminated. The thing to do is to make the people see that they have to co-operate with the insurance interests to get low rates, and the state associations can do much towards educating the public. He said further that the state associations may have all the time necessary at the N. F. P. A. annual meetings to be heard and that they could safely count upon a full half day at each of the meetings if they wanted it. He suggested that not only could the state associations derive benefit from the annual meeting but also that a committee meeting might be arranged following the meeting of the Northwestern association at Chicago in the fall of each year.

Mr. F. G. Snyder of Kentucky said that it stands to the credit of the state and special agents that they have realized the conditions and needs of the fire prevention movement. He was in favor of standardizing the blanks to be used in inspecting various towns, and attention was called to the standard form for an inspection blank recently put out by the National association. Mr. Snyder expressed the opinion that publicity and education must be the foundation for the fire prevention associations work.

Mr. C. B. Roulet, of Texas, gave an account of conditions that exist in that state. He said that notwithstanding that this year would show a $15,000,000 loss on a $9,000,000 premium income, the state has in vogue simon-pure fire prevention methods. In Texas the insurance companies are giving credit in rates for towns adopting fire prevention ordinances. A credit in the basis rate is given for the adoption and rigid enforcement of ordinances. Three cents is allowed for a town fire marshal; three cents for fire prevention education in the public schools; two cents for cash reward for arson.

Capt. J. J. Conway, of the Cincinnati Salvage Corps, said that local agents, who come into direct contact with the people, are the ones who should be educated in fire prevention, and should carry the information to the public. The local agent who knows nothing of fire prevention is a counteracting influence to the work of publicity and education that is going on. He said that the state fire marshal should be taken out of politics. Regarding the adjustment of losses, he held there is too much adjusting

done in a building or office away from the fire, that adjustments should be made on the ground.

He made an interesting new point in saying that much arson is committed by the man who has been systematically stealing from his boss, and sets the fire to cover up his wrongdoing. The time comes for an inventory, and a fire is the only way to prevent exposure.

Mr. Drake, Mr. Page, Mr. Wood, Mr. Crosley, Mr. De Rosset and Mr. Woltersdorf also spoke briefly regarding conditions in their states.

A motion was adopted providing for the appointment by Chairman Hubble of a committee of three on publicity and program for the purpose of systematizing the work of the various state associations, and adopting the best that has been evolved by each. Nearly every state association has developed some new idea of its own which could be adopted to advantage by the other associations. This committee is expected to do much good work in standardizing and making uniform the methods and procedure of the various state bodies.

The meeting adjourned with a common feeling among the delegates that a great step had been taken toward uniformity of action among the state associations, and hence greatly improved efficiency in their work.

Since the Cincinnati meeting an additional association is represented upon this committee in the person of Mr. H. L. Simpson, of Denver, President of the Inter-Mountain Fire Prevention Association, having membership in Colorado, Wyoming and New Mexico, which association has just been elected an active member of the N. F. P. A.

Cleaning Automobiles with a Gasolene Spray.

By Chas. H. Fischer (Member N. F. P. A.)

Since the extensive introduction of the automobile as a commercial and pleasure vehicle, the question of care and maintenance has received much attention from the manufacturer, the garage proprietor and the private owner. This has resulted in the recognized importance of cleanliness. Aside from the improved appearance of a car produced by cleanliness, there is another item which is more far-reaching and important, viz., the economical operation of the car and a reduction in the wear of the moving parts of the machinery. Naturally after any considerable drive an automobile will accumulate a great deal of dust, dirt and grit. Each time a car is driven with this foreign matter on the moving parts there is much unnecessary wear. Therefore, for reasons of appearance and economy there has come into vogue the practice of giving an automobile a thorough cleaning at fairly frequent intervals.

The more common method of cleaning without dismantling has been to wash it thoroughly with a small hose stream, wipe all the machine

parts with a cloth or waste and then polish the body and bright metal parts with a special preparation. This, as must be apparent, is not thorough nor satisfactory. Consequently to clean a car more perfectly it has been found necessary to do a certain amount of dismantling when the machine parts are washed with gasolene or kerosene. The private owner who drives and cares for his own car does not in general relish the idea of putting in so much time and labor in cleaning, and it is likewise with the chauffeur and garage man.

In keeping with the modern movement toward time and labor-saving devices, there has been placed on the market a machine designed for the purpose of cleaning automobiles rapidly and effectively without dismantling. From all information available there are two companies in the East manufacturing machines for this purpose. Essentially these machines consist of a galvanized iron tank of from two to three gallons capacity, provided with a short length of one-fourth inch rubber hose with a long nozzle, a pressure gauge and an air pump fastened to the tank, connected and fitted as shown in the illustration herewith. The tanks of the one manufacturer have riveted seams, while those of the other have soldered seams.

The circular sent out with each machine states that the most rapid and best way to clean auto engines, carburetors, transmisson chains, radiators or other oily parts of an auto is by means of this machine. The directions for the use of the machine say, "Place from one and one-half to two gallons of gasolene in the tank and pump up a pressure of from eighty to one hundred pounds, close the air inlet cock, open the hose and nozzle cocks and spray the parts to be cleaned. Soapsuds may be used instead of gasolene or kerosene for other parts of the auto. When the tank is empty pump up eighty to one hundred pounds and blow the dust from cushions, etc., by air only. Cleaning should be done in open air; guard against hot engine, lighted lamps, etc."

It is apparent from these instructions that the cleaning agency for the oily parts is a gasolene spray under heavy pressure. While soapsuds and kerosene are suggested for other parts these are seldom used. In actual practice a car that is to be cleaned has the hood removed from the engine and the entire machine parts are washed with this fine spray of gasolene. It is stated that after a car has been sprayed, the gasolene is allowed to vaporize and the vapor to blow away before the machine is started. This method of cleaning is done sometimes in the open air, but mainly inside of buildings. That this is an exceedingly hazardous process it need only to be remembered that every pint of gasolene vaporized will make 200 cubic feet of air explosive and that this method of

handling gasolene is especially conducive to rapid vaporization. As usual those employing this dangerous method of cleaning fail to recognize its hazard.

The possibilities of fire and explosion as a result of this method of cleaning may be divided into two classes. First, those originating from the machine being cleaned, and second, those originating outside of the machine being cleaned. Among those originating from the machine being cleaned may be included the following: spraying an automobile with a hot engine or with lamps lighted; spark caused by moving a loose battery connection while cleaning; starting the automobile after spraying and before the gasolene has had a chance to vaporize and blow away. Among those originating outside of the automobile may be included these: while the automobile is being sprayed or after spraying and before the vapor blows away some one of the many chauffeurs or patrons enter with a lighted cigar or strike a match; one of the automobiles in storage is started to be taken out of the garage or an automobile run into the garage; open fires and flames about the work bench or in the adjoining repair shop, such as forge fires, gasolene blow torch, sparks from a direct current motor, gas torches, emery wheels, sparks from electric switches, etc.

It has been rumored that this machine is also used in the cheaper lodging houses in the larger cities for the extermination of bugs and vermin. One of the manufacturers of these machines states that they alone have sold between 200 and 300 of these machines in the states of Massachusetts, Connecticut, New York and New Jersey.

The Efficiency of the Motor Pumping Engine and How to Determine it.

By Geo. W. Booth (Member N. F. P. A.)

The term "efficiency" in the title of this article is to be considered as meaning the power to accomplish the desired work; that is, of pumping, at a fair working pressure, the amount of water corresponding to the rating of the machine, and somewhat lesser quantities at higher pressures, corresponding to conditions under which it may be called upon to operate in actual fire practice.

The tests on which the deductions in this paper are based, were made by various engineers of the National Board of Fire Underwriters, the number tested was not in all cases as fairly representative as we would like, and did not include all the makes now on the market. The conclusions were mostly arrived at after discussion among our engineers, and are to be considered as personal with them.

For purposes of comparison between the performances of the automobile engines tested and of the steam fire engine, there may be noted the following results of tests of three new second size steam engines tested in Chicago in April, 1912; the results are probably fairly representative of what may be expected of this size steam engine. Capacity tests continued for an hour showed an average discharge for the three engines of 725 gallons per minute at a net pressure of 157 pounds; high pressure tests, also continued for an hour, showed an average discharge of 409 gallons per minute at a net pressure of 275 pounds. The net horse-power developed at the pump during these various tests ranged from 61 to 72 and averaged 66½.

A paper on this same general subject was prepared by the writer two years ago. One of the conclusions of that paper was to the effect that

> "Tests of steam fire engines and general modern practice indicate that reciprocating pumps are more efficient and are desirable for this class of work. However, the success of stationary multi-stage centrifugal pumps for high pressure service indicates that this type may be acceptably developed for use on fire engines, as may also the other types of rotary pumps."

Although the centrifugal pump has been used for this service abroad and has been considered here, no fire engines employing this type of pump are as yet in service in this country, to our knowledge; however, other forms of the rotary pump have been used, and give promise of success. The attitude of the engineers of the National Board of Fire Underwriters is that either a reciprocating or a rotary pump is satisfactory for fire engine duty, providing the pump is designed to overcome certain defects which

have been evident in the past, and has proved itself able to do so in service; these defects include lack of efficiency, a tendency to wear and develop high slip which is not easily corrected, and an undesirable amount of vibration in the apparatus.

In order that a fair comparison may be made between the performances of various makes of apparatus, it is necessary to establish a standard for both discharge and pressure, since both these factors enter into a determination of efficiency, that is, work performed. The standard noted in this connection two years ago has been adhered to, and is as follows:

> "That the engine and pump shall be able to deliver the rated capacity of the pump at 120 pounds net pressure, and at least fifty per cent. of its rated capacity at 200 pounds net pressure."

The net pressure is the difference between the readings of the discharge and suction gauges when working at a hydrant, and the sum of these readings when working at draft and the suction gauge indicates a vacuum.

The automobile fire engine is in many ways a more complicated piece of machinery than the steam fire engine, and because of this and the inability to get highly trained men to care for and operate them, their efficiency is liable to fall off considerably in actual service. As a consequence, a certain amount of excess capacity is required, both in the pump and in the engine, to offset this liability and provide sufficient power under all conditions. In regard to the pump, for all except village service, two good fire streams should be available under ordinary working conditions, which, with the modern use of hose with smooth lining and of nozzles of good size and discharging capacity, means an actual delivery of 500 to 600 gallons. With all pumping apparatus, the slip may be expected to increase with use and other conditions will tend to reduce the capacity of the pump, so that a capacity of 700 gallons is not too much for most cases, and for metropolitan service even larger capacity may be desirable. City service, at serious fires when the maximum engine capacity is needed, will most often call for such lengths of hose lines and sizes of nozzles as to require an engine pressure of 120 to 150 pounds, with pressures up to about 200 pounds for fires in high buildings or for suburban service. These figures have therefore been adopted as approximate standards for testing purposes.

As applying to the power of the engine, the tests indicate that under certain conditions likely to occur in practice only 50 to 60 per cent. of the horse-power developed by the engine appears as useful power developed by the pump, as measured by the water discharged and the pressure registered. It is the opinion of all our engineers who have observed tests of automobile pumping engines, that these machines should be provided with high-powered motors, so that it will not be necessary to run them, when the pumps are delivering their maximum capacity, at a speed greater than is safe and reasonable for the long continued service which they may often be called upon to perform. It is believed that a reasonable and reliable speed will be not much in excess of 1,000 feet per minute piston travel, as assumed in the A.L.A.M. rule. Interruptions and breakdowns during tests were most often due to running the motor at high speed. There is a growing

tendency among manufacturers of automobile fire engines towards these high powered motors, since they decrease the liability of heating or other engine troubles, and of vibration and consequent loosening or breakage of small parts.

The discharge of the pumps and the pressure against which they operate are the only factors that need to be considered in judging the performance of an engine. Any given pressure and discharge may be obtained by any one of a number of different combinations of hose lines and nozzles. In our tests, we usually use short lines of hose for the sake of convenience; but it is not always realized that the same pump performance may be obtained in this way as by using long lines of hose and nozzles of a different size, and on this account it is probably better to duplicate as far as possible actual fire conditions. As to test conditions adopted by the fire departments of some of the larger cities, we would say that New York has specifications similar to those printed in our red book, and reading something like this:

"The engine to be able to deliver 700 gallons per minute (or whatever its rated capacity may be) at 125 pounds net pump pressure and at least sixty per cent. (this figure is higher than ours) of its rated capacity at 200 pounds net pressure, with a maximum suction lift of eighteen feet; the length of hose lines and sizes of nozzles to be such that the above results will be obtained, and each test to be of one hour's duration."

This is for steam engines, but the department states that it sees no reason why at least as severe specifications should not be adopted for automobile pumping engines, and has applied it in the case of those it has tested. Chicago has a specification for steam fire engines still more severe, requiring a capacity pumping test and a high pressure pumping test, each of one hour's duration and drafting from lake or river. The capacity test requires a delivery of 700 gallons a minute through two lines of 300 feet of 2½-inch hose, each with 1¼-inch nozzle. The delivery, is of course, measured at the nozzle and means a reading on the Pitot gauge on each nozzle of about fifty-eight pounds. If the hose is of average good quality, the engine pressure will be about 150 pounds. The high pressure test requires the engine to maintain eighty pounds nozzle pressure, measured with a Pitot gauge, while pumping through a single line of 600 feet of 2½-inch hose and a 1¼-inch nozzle; this corresponds to a delivery of 413 gallons a minute, with an engine pressure, if ordinary good quality hose is used, of 318 pounds. Observations by some of our engineers of acceptance tests of three second size steam engines in Chicago last spring showed pump pressures of about 140 and 275 pounds, respectively, for the above noted discharges. These low pressures were due to the smooth lining and ample diameter of the hose used, which had been inspected during its manufacture at the factory and bore the label of the Underwriters' Laboratories; this reduced friction loss, of course, operates to the benefit of the engine, since it meant that for the corresponding discharges a less pump pressure was required than with hose of the usual diameter and good quality, such as was used in determining the values given in our red book. The only objection to specifying definite lengths of hose and sizes of nozzles, together with

either discharge or nozzle pressure, is that the quality and diameter of the hose, so far as it affects the friction loss, will make a material difference in the engine pressure necessary to force a specified amount of water through it; for instance, the labeled hose mentioned above shows a friction loss corresponding to about thirteen pounds per 100 feet for a flow of 250 gallons per minute, the good quality hose used in making the tests for the table in our red book shows about fifteen pounds loss per 100 feet, and the hose used in making the tests at the 1912 Fire Chiefs convention at Denver showed a loss of about eighteen pounds per 100 feet. For this reason the specifications, as worded in our book and as noted in the New York fire department, are fairer and really call for a more definite performance of the engine than specifications defining exactly the length of hose and size of nozzle. However, if there is a call for these latter specifications, or something like them, and it can be assumed that most of the hose in service is of sufficiently good quality to give friction losses about as noted in our tables, then we would suggest requirements something like the following, which are worked out for a 700-gallon engine; any other rated capacity will require different lengths of hose and sizes of nozzles:—

"That the engine be required to deliver for one hour 700 gallons per minute, through two lines of 200 feet of 2½-inch hose, each with 1¼-inch nozzle, with suction lift not exceeding ten feet (this discharge will correspond to a Pitot gauge reading of fifty-eight pounds and a pump pressure of about 118 pounds).

Note.—Practically the same result will be obtained by the use of three lines of 2½-inch hose 600 feet long, each with 1⅛-inch nozzle pressure of thirty-nine pounds, or three lines of 2½-inch hose 400 feet long, each with 1-inch nozzles and nozzle pressure of sixty-two pounds; or by the use of two lines of 2½-inch hose 200 feet long, siamesed into a deluge set, with 1¾-inch nozzles, and nozzle pressure of fifty-nine pounds.

"The engine shall also be required to deliver at least 350 gallons per minute through a single line of 500 feet of 2½-inch hose, with 1¼-inch nozzle, with suction lift not exceeding ten feet (this discharge will correspond to a Pitot gauge reading of fifty-eight pounds and a pump pressure of about 204 pounds)."

If the engine proves unable to deliver the expected amount of water at the desired pressure, it is necessary to use longer lines of hose or smaller nozzles, in order to back up the pressure and reduce the discharge; the same effect will be produced by partly closing one or more of the discharge gates of the engine. Likewise, for an engine of any other rated capacity than 700 gallons, different combinations of hose lines and nozzles are necessary. These combinations may be derived from the tables on pages 30 and following of the last edition of our red book, or may be found in part on pages 20 and 21. Altogether, it will be seen that it is not so simple as appears at first sight to formulate specific requirements covering engines of various rated capacities and hose of varying size and quality. If no Pitot gauges are available and the nozzle pressure can not be obtained, a reading of the pressure gauge on the pump is usually a fair measure of discharge, but this method is not advisable because the pressure gauge is very apt to fluctuate violently and is difficult to read (many observers will record the top of the swing rather than the average, which is really the correct read-

ing), and because if one or the other of the discharge gates on the pump is partly closed, the pump pressure will be backed up and the actual discharge reduced, thus conveying a wrong idea as to the number of gallons delivered, as determined by the tables in our red book. We have known this to happen in practice a number of times. The best and only reliable way to determine delivery is to measure it at the nozzle with a Pitot or a piezometer gauge. In making tests under any conditions, there are some few points which are necessary to observe carefully. Testing nozzles should be smooth bore, without ring or shoulder, and care should be taken that they are not nicked or otherwise injured, and that washers do not project into the pipe. The diameter of the nozzle should be determined at least to the nearest hundredth of an inch, and closer if a Vernier caliper can be obtained. If the diameter varies materially from stock sizes, the discharges must be modified from the tables on pages 28 and 29 of our red book by interpolating between the figures there given. Also, and in most cases fully as important as the correctness of the nozzle diameters, is the calibration of the nozzle and engine gauges, especially the former, to determine whether they read correctly. We have known of cases where these gauges were as much as ten pounds or more too high, which, of course, credits the engine with doing more work than is actually the case and accounts for some of the results published, which on the face of them are altogether improbable, if not impossible. The calibration or comparison of gauges may be done with a weight tester, or by a hand tester in comparison with a standard test gauge known to be correct; the readings taken during engine tests should be corrected by the amount of deviation from the standard, if any. Another point is that in taking readings with a Pitot tube, this should not be inserted inside the nozzle, but held so that the tip of the tube is half an inch away from the face of the nozzle. If the tube projects into the nozzle the area of the waterway is decreased and the velocity of discharge correspondingly increased; this has the same effect as decreasing the size of the nozzle, while at the same time credit is given for discharge from the full area, the result being a greater indicated discharge than is actually the case.

In a broad consideration of the relative value of motor-driven and horse-drawn fire apparatus, there must of course enter the question of the advantage gained by quickness of response, but this question has not been considered in this paper; if then we have in mind only the ability to pump water, there appears to be no reason why we should not place the motor pumping engine in comparison with the machine it is displacing, the steam fire engine. In making such a comparison, there is one feature on which we have not yet sufficient data to base a definite conclusion, namely, the ability to operate efficiently and without serious interruption at fires extending over long periods, and especially under adverse weather conditions. It is not intended to argue that automobile pumping engines may not have this ability, but simply that they have not proved it, as have steam fire engines; we believe that they will be developed to possess this ability, if they do not possess it already, and observation and reports by the members of this Association will be the best means of deciding the question.

Another question, which can in many cases be answered with certainty only after apparatus has been in service for some time, is the effect of depreciation with age and use, as indicated by ability to successfully withstand long and severe service without injury or breakdown of any of its parts. In designing any new type of apparatus, it is of course to be expected that there will be certain features susceptible to improvement; some of these faulty features have already been discovered and corrected, and the desire and intention of the manufacturers to perfect their product is encouraging.

Improvements in design will undoubtedly result in a simplification of the machine, and a general reduction of the number of parts and in some cases of the weight of the apparatus. Automobile fire apparatus does not receive as constant service as commercial apparatus, but its use is generally more severe; considering everything, we see no reason why it can not be constructed to have a life almost as great as the steam fire engine, and to maintain an equal efficiency. To obtain these desirable results, proper design and construction are essential; following these, the point which requires perhaps the strongest emphasis is the necessity for skilled attention and proper and intelligent care of automobile apparatus, especially pumping engines: the necessity for attention can be determined in many cases only by tests which will duplicate conditions obtaining at a hard fire, and these tests should be made systematically and at least once a year. There is therefore a necessity, especially in a department where much motor apparatus is in service, for a superintendent of machinery, fitted for the position by skill and experience in this line, or with energy and capacity to so fit himself; he should be zealous in training engineers and drivers to do their work properly and should personally supervise such tests as are necessary to assure himself of proper care and condition of apparatus.

The Relative Corrosion of Iron and Steel Pipe as Found in Service.

By William H. Walker.

Abstract of a paper read before the New England Waterworks Association.

There are few subjects relating to the corrosion of metals which have received so much attention, or around which there has centered so spirited a discussion, as the relative merits of iron (meaning thereby wrought iron) and steel. The fact that this matter is one still receiving attention, notwithstanding the great volume of accumulated and available literature, is due to a number of causes, among which may be mentioned: First, that although the words "iron" and "steel" carry with them a definite idea as to general methods of manufacture, and some of the more easily discernible properties, they convey no idea as to standards of value. It is possible to make very poor iron and very good steel, and it is just as possible to make

the reverse. Hence, when an investigator compared the corrosion of a poor iron with a good steel, he obtained results which favored steel; when the material under study was the reverse, iron was shown to be the more resistant metal. Second, there is a woeful lack of uniformity of conditions obtaining in many, if not most of the experiments which have been carried on for the purpose of comparing resistance to corrosion. Some specimens were large, some small; some cleaned of scale, others not; some immersed in deep water, others in shallow water; etc. The corrosion of iron is so sensitive to changing conditions of surface, oxygen concentration, salts in solution, and the like, that only when the most careful preparation is made to maintain all conditions constant, is a comparative test of value. We will not discuss these conditions here, but take pleasure in referring the reader to that most excellent book on "The Corrosion of Iron," by Dr. J. Newton Friend,* where a complete treatment of the general subject will be found. Third, many times opinions are formed and expressed by the casual observer which fail to take into consideration not only the fundamental conditions necessary to accurate comparative work, but also less obvious conditions which make a comparison unreliable. For example, a person may notice the rapid rusting of a cheap grade of steel wire fencing which had originally but a wash of zinc as a substitute for galvanizing, and thus become suspicious of the durability of all steel. Or he may notice holes in a metal roof put up in place of a material known to have lasted a much longer time than the new roof. He concludes that the latter is of less value without having any knowledge of the change of conditions in the locality, class of metal and the thickness of the new roof, nature and thickness of the galvanizing or other protective coating, and so forth.

Owing to the proverbial conservatism of New England, the introduction of steel pipe has been slower in this territory than in other parts of the country. There is a tendency to pronounce any pipe which withstands corrosion as being wrought iron, while the fact that a pipe corrodes easily is considered by many proof in itself that it is steel.

To determine what the facts actually are in regard to the relative life of service pipes which have been in constant use for a number of years throughout New England, an investigation was undertaken in which it was proposed to seek out instances where steel and iron pipe had been used together in the same system; and further, where the two kinds of metal were separated in this system only by a coupling. Any influence which the coupling might have would be present equally with the iron and with the steel, while conditions of oxygen concentration, temperature, pressure, flow of water or steam, etc., would be as nearly identical for the two kinds of metal as it is possible to obtain. It was intended also to collect in this way material of known resistance or tendency to corrosion, in order to further test the applicability or truthfulness of the so-called "acid corrosion test." While the majority of the pipe so obtained was from hot and cold water feed systems, enough were selected from live and exhaust steam lines,

* "The Corrosion of Iron and Steel," by J. Newton Friend. Longmans, Green & Co., New York.

hot water and steam heating systems, etc., to make the conclusions drawn of general application. The investigation was necessarily tedious, in that each pipe had to be examined to determine whether it was of iron or steel; and many instances were found that would have served our purpose well, but where it was impossible to remove the pipes from the system. The pipes were sent to the laboratory, where they were each split lengthwise into two halves, and carefully cleaned from scale and rust by soaking in an ammonium citrate solution, with an occasional brushing. In this way the scale and rust were removed without dissolving any of the iron. An estimation of the extent of corrosion was made by measuring with a micrometer gauge the ten deepest pits per unit distance of length. I give the measurement of those samples of pipe which were rusted to practical destruction; that is, where either the iron or the steel showed pits over one tenth of an inch in depth.

	Depth of Pitting.		
	Mean of Ten Deepest Pits.	Deepest Pit.	Least of Ten Deepest Pits.
Sample Number.	Inches.	Inches.	Inches.
W-10—Iron	0.102	0.134	0.085
W-11—Steel	0.075	0.095	0.067
W-22—Iron	0.114	0.160	0.068
W-23—Steel	0.075	0.107	0.042
W-24—Iron	0.139	0.168	0.109
W-25—Steel	0.140	0.204	0.076
X-15—Iron	0.077	0.101	0.069
X-16—Steel	0.040	0.047	0.034
X-29—Iron	0.042	0 060	0.030
X-30—Steel	0.066	0.103	0.042
X-49—Iron	0.077	0.113	0.049
X-50—Steel	0.071	0.122	0.040
X-57—Iron	0.038	0.110	0.012
X-58—Steel	0.026	0.053	0.012
X-69—Iron	0.113	0.159	0.032
X-70—Steel	0.119	0.177	0.095
X-71—Iron	0.115	0.169	0.063
X-72—Steel	0.075	0.156	0.042

The results are a splendid vindication also of the principle that if oxygen be excluded from water, no corrosion will take place. When the water in the lines examined was stagnant, as in fire sprinkler system for buildings, or in lines where the water was circulated over and over again without exposure to the air, as in some hot water heating systems, no corrosion was to be observed. On the other hand, where fresh water was constantly added to the system, and heated within the system, corrosion was very rapid, and in some cases excessive.

We were able to get sixty-four comparisons of iron and steel where the history of the installation was known. The results are as follows:—

Comparison where iron was found more corroded than steel..... 20
Comparison where steel was found more corroded than iron..... 18
Comparison where steel and iron were equally corroded..... 9
Comparison where corrosion was negligible..... 17

These results again demonstrate that taken on the average there is no difference in the corrosion of iron and steel pipe. Conversations held with the engineers in charge of plants during this investigation confirm the statement already made that a pipe is frequently called steel when corrosion is found to be excessive, while it is set down as iron if it rusts but little.

In order to get some measurement of the influence of oxygen in the water of the modern hot water supply system, a relatively large scale experiment was carried on at the plant of the Walworth Manfg. Co. in South Boston. Two coils made up from pieces taken from the same length of pipe were each fed with water from the same source at the same temperature. In one case the water was heated to 85° C. in an open tank, while in the other the water was heated to the same temperature in a closed tank. The feed water contained on the average 5.85 cc. of oxygen per liter, and passed through each coil at the rate of one-half gallon per minute. After running 1,750 hours the coil fed with water heated in an open tank had lost twenty-two grams, while the coil fed with water heated in a closed tank had lost 155 grams. In neither case was the oxygen completely removed; if the water in the open tank had been gently boiled, corrosion in the coil fed with this water would have been entirely prevented.

In order to show what relation may exist between the so-called acid corrosion test and the real corrosion as found in service, eleven pairs of iron and steel were selected and subjected to twenty per cent sulphuric acid for four hours at room temperature. Four pairs were selected in which the steel was decidedly better than the iron in service, four in which the iron had shown decidedly better than the steel, and three in which there was no difference between the two metals.

In six instances the relative corrosion, as shown by the sulphuric acid test, corresponded with the corrosion as found in service. In five instances corrosion as shown by the acid test was exactly contrary to that found in service. Although the greatest care was taken to have the specimens of the same size, cleaned in the same way, and in the same physical condition, the results show that no reliance can be placed in this accelerated acid test, but that it may be entirely erroneous and very misleading. Not only did the acid test not agree with service test when steel was compared with iron, but the steels failed to agree among themselves, and the irons showed no agreement when considered by themselves.

Natural Gas Gasolene.

Walter O. Snelling wrote in *The Natural Gas Journal* an article entitled "Liquid Gas." In this article he discussed the subject of natural gas gasolene. This subject was also considered in Technical Paper No. 10 issued by the Bureau of Mines, entitled "Liquefied Products from Natural Gas," written by Irving C. Allen and George V. Burrell. From these sources we have prepared the following article.

Natural gas may be divided into two great classes, (1) so-called "dry-gas," known and used for many years as the natural gas of commerce, and (2) a gas containing easily liquefiable vapors, which is known in the vicinity of the oil fields as a "wet gas." The latter class forms the basis for the so-called "natural gas gasolene" industry.

By fractionating natural gas, either during or after liquefaction, four products can be commercially obtained. Roughly these four products may be described as follows: (1) The gaseous product, the common natural gas of commerce; (2) the semi-liquid product known as the new "wild" product, which should be used only as a liquefied gas and should be held in high-pressure steel containers only; (3) the light liquid product, or light gasolene, used for blending with heavy naphthas; (4) the heavy liquid product, or ordinary high-grade gasolene.

It has long been known that during cold weather a liquid collects in the exposed pipes at many natural-gas wells. At first the matter was regarded solely as a nuisance, since drip-tanks had to be installed to separate the liquid from the gas, and when a considerable quantity of the liquid accumulated in the tanks they had to be emptied.

That the liquid which thus collected in the drip-tanks was gasolene was probably recognized by many persons, but for a period of several years there appears to have been no realization of the significance of the fact, and practically no attempt was made to utilize the product. After some years of this waste, the collection and utilization of the gasolene seems to have come to the mind, at about the same time, of several men in widely separated localities. In the Pittsburgh district the early pioneers in this development made arrangements with the lessees of a number of gas wells, by which they were allowed to draw off the liquid from the drip tanks, and dispose of it for a part of the profit realized.

The gasolene which was thus obtained was a perfectly transparent and colorless material, of very satisfactory grade. With systematic effort to

collect this material came the observation that different sources of natural gas differed greatly in regard to the amount of gasolene which was produced, and the conditions under which it would separate.

Natural gas which came from the earth under high pressure would seldom give a liquid condensate, even in the coldest weather, while the very heavy gases which come from oil wells, and which are under very slight rock pressure, would frequently give an abundant supply of gasolene.

With the coming of summer, as the temperature out-of-doors became higher, even the amount of liquid which collected in the best wells became greatly lessened. It was to regain the profit which was thus found to be slipping away that the earliest efforts were made at compressing and cooling natural gas, in the efforts to separate from it the gasolene which it holds in the form of vapor.

It was found possible to prepare gasolene of excellent quality by simply compressing the natural gas in an ordinary air compressor, and then passing the compressed gas through cooling coils, connected to a suitable drip-tank from which separated gas could be drawn off. From the heavy or "wet" natural gas of oil wells it is not uncommon to get six or seven gallons of gasolene from each thousand cubic feet of gas treated, and there are many gas fields from which three to four gallons of gasolene per thousand cubic feet of gas may be obtained.

Even with compression and cooling, it is not possible to produce gasolene from natural gas which comes from the earth under high rock pressure, and this is naturally to be expected, since such gas consists almost entirely of methane, and the natural pressure which exists in the earth has been sufficient to prevent its carrying any considerable amount of the heavier hydrocarbons.

At the present time the industry of producing gasolene from natural gas has assumed large proportions; some hundreds of plants are already in operation, and the aggregate production has reached many thousand gallons per day, most of which is sold as a blended product, composed of a mixture of refinery naphtha and natural-gas gasolene; this blended product giving excellent results for all the purposes for which ordinary refinery gasolene is used.

With the earliest attempts at utilizing the new gasolene, attention seems to have been called to the fact that it was in nature not identical with ordinary or refinery gasolene. Some natural-gas gasolene contains dissolved gases to such an extent that when resting quietly in a glass vessel it effervesces or "boils" strongly, and gives off vapors so rapidly that its volume is greatly reduced by standing, even for a period of an hour or so. That the vapors thus given off formed an explosive mixture with air was forcibly shown by a series of accidents which were associated with the early efforts in the use of natural-gas gasolene. It was in the effort to find a means of separating from natural-gas gasolene its dissolved gases, that studies in connection with this subject were made, which led to methods of manufacturing liquid gas.

Repeated efforts had been made to separate the dissolved gases by

distillation. In many cases the gasolene produced at the compressor had been placed in steel vessels heated by steam coils, and there warmed until a half or more of the gasolene had been evaporated. Even after this wasteful treatment the remaining gasolene was found to contain dissolved vapors to such an extent that it gave abnormal pressures when tested, and gave off gases to such an extent as to be considered dangerous.

Efforts were made by some of the producers of natural-gas gasolene to free their product from dissolved gases, by exposing the material to the air, in shallow tanks, and at one plant over seventy-five per cent of the condensate produced was allowed to evaporate into the air, in the effort to obtain a satisfactory product; but even in this extreme case the tendency of the vapors which escape to carry with them the heavier products, and the tendency of the heavier residue to still retain a portion of the dissolved gases, made this method not wholly successful, even after three gallons of condensate out of every four gallons produced had been allowed to go to waste in the air.

It is well known to physicists that there is for each gas a critical temperature, above which no amount of pressure, however great, will reduce it to the liquid condition. It appeared, therefore, feasible to certain investigators to utilize the critical pressures of the different gases as a means for their separation.

By some suitable arrangement it was thought possible to volatilize a mixture consisting of ethane, propane, butane, pentane and hexane, for example, and then under high pressure to introduce into such mixture a coil heated by means of superheated steam or hot water to such a temperature as to be above the critical temperature of ethane and propane, for example, but below the critical temperature of butane, hexane and pentane; and under these circumstances it seemed natural to suppose that the liquid which was separated by means of the coil would consist mainly of butane, pentane and hexane, and that the ethane and propane would be left as uncondensed gases, to be condensed as a subsequent operation.

By means of a series of coils, heated to different temperatures intermediate between the critical temperatures of the different gases, it was found possible to fractionate the vapors from natural-gas gasolene, so as to obtain as one fraction gasolene equal in every respect to the best refinery gasolene, and this result was achieved without the loss of any of the original products.

The critical temperature of a gas is a physical constant, and is not changed by pressure; and the selective condensation of vapors under very high pressure (up to 1000 pounds per square inch) upon hot coils higher in temperature than the critical temperature of part of the gases present, promises to give important and valuable results, not only in the preparation of liquid gas, but also in other refining operations. In its nature the new process of refining is entirely different from the ordinary method of fractionation by distillation.

The material which condenses upon the last coil in the series consists of ethane and propane, two gases which may be readily changed to the

liquid condition by pressure and cooling, but whose boiling points under normal conditions of pressure are many degrees below 0° C. That these gases, liquefied and contained in strong steel cylinders, would form an ideal illuminant seemed evident, and further experiments to determine the possibility of so producing and utilizing them were carried on.

Tests made with great care have shown that it is possible to produce from natural gas, by a combination of the methods of stage compression and rectification, gasolene of the most excellent quality, and equal in every respect to the best grades of refinery product, and, in addition, to recover all of the ethane, propane and butane, as a liquid gas, in such a form as to make it a convenient, safe, clean and cheap method of lighting isolated dwellings, such as country homes, seaside resorts, lighthouses and light buoys, etc.

For many years the waste of natural gas in the United States has reached enormous proportions. Dr. I. C. White, State Geologist of West Virginia, has in particular called attention many times to the enormous extent to which natural gas and oil-well gas was being allowed to escape, with the consequent loss to the nation of the equivalent in heating power of many millions of tons of coal. On December 31, 1911, there were 10,809 productive wells in Pennsylvania, 4,755 in West Virginia, 4,717 in Ohio, 2,633 in Indiana, and 2,004 in Kansas. The total number of productive wells in the United States on that date was 28,428.

During the last three years the separation of the more volatile grades of gasolene from natural gas issuing from oil wells has become a profitable industry of increasing importance. The industry did not progress as rapidly in 1911 as was expected. Undoubtedly it will eventually become a settled and flourishing business, for millions of cubic feet of gas that is now wasted on leases might be converted into gasolene, should the demand and price warrant it.

Plans are already under way to utilize some millions of cubic feet of gas daily in the production of gasolene and liquid gas, and thus to add decidedly to the national supply of both gasolene, a material which is finding each day ever-widening uses, and liquid gas, a product which seems destined to play a large part in the lighting of isolated dwellings.

The Transportation of Natural Gas Gasolene.

By Bureau of Safe Transportation of Explosives (Member N. F. P. A.).

The special hazards in transportation of natural gas gasolene were first brought to the attention of the Bureau of Explosives during the latter part of 1909. A number of instances were then reported in which iron drums containing this product had burst during transit, either on the cars or on freight platforms. A cursory investigation at that time showed that this material was being made in small quantities at a few points in Pennsylvania, Ohio and New York, and that the product was being shipped in iron drums exclusively. Examination of the ruptured drums showed, in every case, that they were much lighter and weaker than the drums commonly used.

The product being shipped at that time was 86–88° Beaume gravity. The volume of traffic was small, and the substitution of a better quality iron drum, made according to specifications prepared by the Bureau of Explosives, after consultation with the manufacturers, was sufficient to prevent any further accidents of this kind.

The rapid increase in the production of the natural gas gasolene later led to its shipment in tank cars. In April, 1911, a very disastrous accident in opening a tank car at St. Louis, Mo., again called attention to this traffic. A rigid investigation was made into all phases of the industry and traffic that affected safety in transportation. It was found that this natural gasolene was being shipped from fifty-eight different points scattered over nine states. The products were far from uniform, variations being due to the methods of compression and condensation, and to the composition of the gases from which it was derived.

Some of the products varied but little from ordinary refinery gasolene, while others were exceedingly volatile and contained large quantities of products which boiled off rapidly at atmospheric pressure. These latter are commonly spoken of as being "wild." It was the usual practice to store these "wild" gasolenes for some time in a vented tank prior to shipment, thus permitting the lightest portion to pass off into the air. This process was known as weathering. During the weathering the evaporation of the lighter products reduced the temperature of the contents of the tanks to a very low point, the outer surface of the tanks often being cov-

ered with a coating of frost and ice several inches thick. This weathering, while eliminating some of the most volatile portions of the product, thus lessening the risks of transportation, also caused a great shrinkage in volume, and thus a loss to the producer. There was always an inducement to ship the material with as little weathering as possible so as to deliver the maximum output of the plant.

All tank cars used for inflammable liquids are made according to specifications of the Master Car Builders' Association. One of the requirements of these specifications is that each tank car must be provided with safety valves of a specified area set to blow off at eight and twelve pounds pressure per square inch. The obvious purpose of these valves is to prevent the explosion of the tank in case it is exposed to external fire, but to retain the inflammable vapors produced by the liquid contents at the ordinary climatic temperatures. Investigation showed that some of the tank cars loaded with natural gas gasolene had suffered very considerable loss in transit merely by blowing off gas through the safety valves. The periodic escape of such inflammable vapors in large quantities from cars in transit is evidently prejudicial to public safety. On the other hand, there was the possibility that the safety valves might, by some means, be put out of service, and the tank itself be subject to excessive internal pressures. Such failure of the safety valves might appear to be a distinct gain to the shipper, as the ordinary losses by evaporation were thereby diminished or entirely prevented.

The peculiar transportation risks incident to the "wild" natural gasolene were the exceedingly high vapor pressures produced in the shipping containers at the ordinary summer temperatures prevalent throughout the country. The lightest refinery gasolenes produced by distillation are well known to have a fairly high vapor pressure, but many of the natural gasolenes, as offered for shipment, gave pressures more than double that produced by the lightest refinery gasolenes.

A simple apparatus was constructed to determine the vapor pressures at various temperatures. It consisted of a short section of two inch steel pipe with caps screwed on each end. The upper cap had a one fourth inch nipple screwed in, and was connected by a coupling to an accurate pressure gauge. The test was made by filling the apparatus to ninety per cent of its capacity and sealing tightly. It was then immersed in water of the desired temperature, and after allowing a few minutes for the temperature to become uniform throughout the entire apparatus, the pressure was read directly from the gauge. The results obtained on a very light refinery gasolene and an ordinary natural gasolene are given below:—

	Refinery Gasolene	Natural Gasolene
80° F.	4.0 lbs.	8.0 lbs.
90° "	6.5 "	12.0 "
100° "	10.5 "	16 5 "

The natural gasolene tested was not the lightest or wildest product produced, and had been subjected to considerable weathering previous to

testing. It is obviously unsafe to ship such material in the usual tank cars during the summer months, as the vapor pressures will largely exceed the pressure at which the safety valves are set.

The making of pressure tests on these gasolenes appears to be very simple, and it was assumed that concordant results could readily be obtained. It soon appeared that there were great discrepancies in the pressures observed from the same gasolene at a given temperature. This variation was found to be due to variations in the temperature at which the liquids under test were sealed up in the pressure apparatus. To show the extent of this variation caused by the temperature of sealing the test apparatus, the same sample of gasolene was tested for vapor pressure, the apparatus being closed at 70° F., at 35° F. and at 0° F., respectively. The results obtained are tabulated as follows:—

Test Temperature	Sealed at 70° F.	Sealed at 35° F.	Sealed at 0° F.
70° F.	..	7.0 lbs.	10.5 lbs.
80° "	4.0 lbs.	9.5 "	13.5 "
90° "	6.5 "	12.0 "	16.0 "
100° "	10.5 "	15.5 "	19.5 "

These increases of pressure are due to air dissolved in the liquid at low temperatures and again forced out of solution on raising the temperature. The same effects were observed with refinery gasolene, natural gasolene, kerosene, ether and carbon bisulphide, and are no doubt common to other inflammable liquids.

In order to obtain comparable results it would appear necessary always to seal up the sample to be tested at a constant temperature. There are two objections to doing this exactly. If the starting temperature is taken very low, say 30° F., it is impracticable to always bring samples to this temperature, as most of these tests of necessity are made in the field with the most meagre facilities. If the initial temperature is taken at a higher figure, say 70° F., and it is attempted to bring some of the wild natural gasolenes to this temperature before sealing, a very considerable portion will distill off, and the part remaining to be tested will not properly represent the product to be shipped. Both of these difficulties may be avoided by filling the test fount at whatever temperature the gasolene in the storage tanks may happen to be, sealing it immediately and the bringing it to the temperature of 70° F. The apparatus is opened momentarily to allow the escape of air and vapor, and immediately sealed again. The temperature is then raised to higher temperatures and the resulting pressures observed, as previously described.

Owing to the excessive pressures produced by some of the natural gasolenes, it was necessary to restrict the use of tank cars to products giving vapor pressures of ten pounds per square inch or less at 100° F. during the summer months, and a similar pressure at 90° F. during the winter months, the pressures to be determined as just described. Gasolenes giving pressures above these limits, but not greater than twenty-five pounds

pressure at 100° F., are shipped in iron drums complying with the specifications prescribed by the Interstate Commerce Commission. Products giving pressures above twenty-five pounds per square inch at 100° F. are required to be classed and shipped as compressed inflammable gases. These restrictions prevent the tank car shipment of much of the product and require either the use of iron drums, or that the weathering process be carried on till the residue comes within the prescribed vapor pressure limits. In either case the shipping costs were largely increased.

In order to promote the safe and economical shipment of these products in the future, the Master Car Builders Association, pursuant to the federal regulations, have devised a new style of tank car, after exhaustive tests as to the results of exposing tanks of the natural gasolene to intense external fire, and observing the action with safety valves of varying area and set at different pressures. The new tank car will be considerably stronger than the ordinary cars. It will be insulated with a layer of asbestos or magnesia lagging, and will have safety valves set at twenty pounds pressure.

Gasolene giving vapor pressures up to twenty pounds per square inch at 100° F. will be permitted shipment in these new tank cars, and not only will there be greater security against accident, owing to the greater strength of the car, but there will be less loss from evaporation owing to the insulation protecting the contents of the tank from the higher temperatures. At the time of writing these new tank cars have not yet been constructed, but there is no doubt that the shippers will take advantage of the economies effected by adopting this car for transportation of much of this new product.

There is already a development of the natural gas gasolene industry to separate the most volatile condensable products from the "gasolene" for use as a fuel and an illuminant. This product will be compressed and liquefied under very high pressures and will be applicable to many of the same purposes as Blau and Pintsch Gas. Like them it will be shipped in heavy steel cylinders and be subject to the Interstate Commerce Regulations for compressed inflammable gases. This new development will improve the gasolene by removing the most volatile portions, which are the source of its peculiar hazard and are, at the same time, so likely to be lost entirely during the handling of the liquid products.

A Combined Sprinkler and Heating System.

By Gorham Dana (Member N. F. P. A.)

In the weave shed of a large cotton mill in New Bedford there was installed about two years ago a combined heating and sprinkler system. The building is of large area (300 by 237 feet) basement and one story in height. The sprinkler system is fed by an eight-inch pipe from the yard mains supplied by city water and a steam pump. There is a check valve on the eight-inch pipe just inside of the building.

In the basement the entire sprinkler system is used as a heating system and there is no other heat. There are check valves in the larger branch pipes close to the main feed pipe to prevent circulation in the latter. The ends of all branch lines are tied together and connected to two four-inch headers or supply pipes from the hot water heater. This heater is located in the basement of the engine room adjoining, and the four-inch pipes are run from the sprinkler system into the heater, making a complete circuit. The hot water starting in one four-inch pipe circulates through all the smaller sprinkler pipes and returns through the other four-inch pipe.

The weave shed above has a sawtooth roof, with sprinkler branch lines running to dead ends at the top of each sawtooth. Here no attempt was made to use the smaller sprinkler pipes for heating purposes, but the heat is obtained by circulating the water through the larger sprinkler pipes and some auxiliary heating coils.

Perhaps the most interesting feature of this system is the method used for preventing the operation of the sprinkler heads from the heat of the water. The heads are of the Grinnell glass button type, and are practically all low test, melting at about 160° F. The hot water has an average temperature of 180 to 200°, the maximum temperature used being about 245°. In order to prevent overheating the sprinklers, they are placed on short offsets in which the water does not circulate. The offsets in this case are of one-half inch pipe and are about one foot long. They are placed about three inches above the main pipe and connected to it by a one-half inch elbow and nipple. This size of pipe is too small to give standard sprinkler protection, and three-fourths inch pipe should and probably could be used without serious results. It is stated that the action of hot water on the iron pipe causes the segregation of nitrogen gas from the

entangled air in the water, and this is a good non-conductor. The gas collects in the small offsets and after a period of time practically fills them. While this gas is a good insulator, the fact that the sprinkler heads do not open is primarily because the heat is radiated from the offset and from the head faster than it is supplied to them by conduction. Also because there is no circulation in these offsets. While no heads have as yet opened from the heat of the system, the frames become so hot that one cannot bear the hand upon them for long without discomfort. The struts, however, are noticeably cooler than the frame. Whether this feature would be so marked in heads of other types is not known.

This system, slightly modified, is now being installed in a mill in Lewiston, Me., and it seems likely that unless some unforeseen trouble arises it will soon come into considerable prominence.

The great advantage of such a system is plainly the saving in the cost of pipe in the original installation, which saving has been estimated at thirty-three per cent.

There seems to be no serious disadvantage from a fire protection standpoint except that there is also more danger of having to shut off the sprinkler system for repairs than in cases where the two systems are separate. It might also interfere with the proper action of an alarm valve, although in the installation described there is no such device. With certain kinds of water there might be trouble from corrosion or clogging in the pipes.

The system should not interfere with the proper operation of a sprinkler in case of fire, and while hot water might be thrown onto the fire for a short time the cold water would soon follow. The hot water while it lasted would not be quite as good a fire extinguisher as that of the ordinary temperature, as it would be more quickly converted into steam.

These possible defects would probably not offset the defects inherent in a dry sprinkler equipment, and the system would therefore be of especial advantage in cold buildings that would otherwise have to be sprinklered on the dry system.

Further experience is believed to be necessary before it can be definitely determined whether this system is thoroughly practical and economical.

Color, Paint and Varnish Factories.

By F. E. Roberts (Member N. F. P. A.).

Part II. Paint Factories.

The old formula for an ordinary paint is an intimate mixture of white lead used as the principal pigment or "body" coloring pigment, linseed oil, turpentine and a japan or "drier," containing nothing more volatile than turpentine. No doubt this expensive formula is used to-day for the manufacture of some paint; but there is also no doubt that a large amount of paint is made in which substitutions, additions and alterations prevail in a greater or less degree. While there may be some additional hazard in grinding, if an adulterated linseed oil is used, the principal increase of hazard will be in the thinning stage. There the hazard of inflammable vapors is materially increased, owing to the fact that benzine may be a component part of thinners and driers and used directly as well. In fact, we may expect that more or less benzine, in some form or other, will be employed in the paint factory of to-day, and it does not necessarily follow that the factory using a small amount is less immune to fire than the one where a much greater quantity is consumed.

Oils. Some of the oils that may be employed as adulterants of, or substitutes for, linseed oil are menhaden, cotton seed, corn and rosin oils, and recently an oil made from the Soya bean imported from Japan and Manchuria. Also by indirect processes linseed oil can be made to combine with a considerable proportion of water. It is said that petroleum products may be used as adulterants. One turpentine substitute prepared by distilling pine needles, young twigs and fresh pine wood is more hazardous than turpentine. There are said to be substitutes consisting wholly or in great part of petroleum products, which have as high a flash point as turpentine (about 100° F.). However, there are also substitutes in which the flash is very much lower, and it is safe to assume that turpentine substitutes generally will be more hazardous, as regards giving off vapors at ordinary temperatures, than turpentine. Turpentine itself ignites easily, burns rapidly, has the spontaneous ignition hazard, and is a much more hazardous article of storage than linseed and like oils which belong to the safe class in all respects except that of spontaneous ignition. Linseed oil stands at the head of all other oils in regard to this danger.

Driers and Japans. Driers used in the process of boiling linseed oil and manufacture of oleo-resinous varnish and japans are solid sub-

stances, principally salts of lead and manganese. The japan which may be employed as a thinner and drier in paint factories consists of linseed oil and solid driers boiled down at a high heat to a thick mass thinned out for use with turpentine or benzine. Japan for grinding japan colors is practically an oil or oleo-resinous varnish thinned with turpentine. The black japan, familiar in dip tanks, is essentially a black varnish of which asphaltum usually forms the base.

Processes. The process of making an ordinary paint consists of mixing pigments with oil, grinding such mixture to a smooth paste and thinning the paste to the consistency of paint with oil, japan, turpentine or benzine. The resultant paint may be strained through wire netting and is canned either in self-sealers or soldered containers. Paste paint is the paste referred to above which is barreled and sold to various manufacturers who thin it out according to their own ideas. This is no guarantee that benzine will not be used, and may mean that conditions of such use are not so good as in the paint factory.

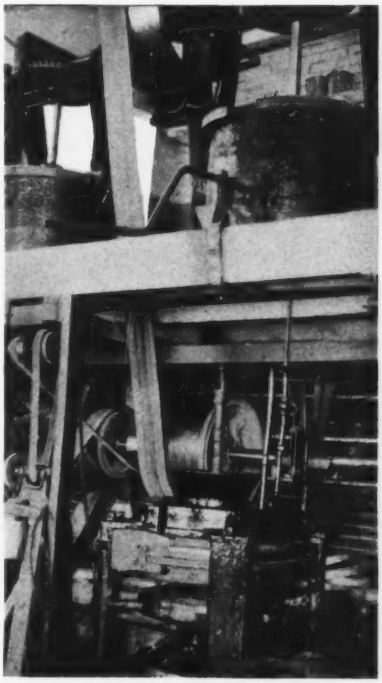


Fig. 5.
Pug Mill above. Buhr stone Mill below.

Materials. Painters' colors are coloring pigments ground to a paste in oil canned in that form. Coachmakers' colors are the same ground in japan. Paste fillers are a mixture of silex (ground quartz), pigment, oil and japan. Enamels are paints in which varnish takes the place of oil to a large extent. Varnish stains, sold under that name or under various fancy titles, are practically colored varnishes. Oil stains may be considered as a thin paint. Putty consists of whiting and low grade linseed oil containing water and mucilaginous matter incorporated together by an edge runner or "chaser." In some low grade putty a better description of the liquid might be mucilage contaminated with a little oil. Shellac varnish, often called simply "shellac," is a product of most paint factories and consists of gum shellac, partially dissolved, put into a closed barrel which rests in a horizontal position on trunnions in each head, and is rotated slowly on its horizontal axis by power. Sometimes the trunnions are placed out of the center in opposite directions which gives a

"wobbly" rotation,—quite appropriate for an alcohol container! There are some stains in which the liquid is practically all wood alcohol, benzine or some mixture of volatile material. Also "reducers" or "turpentine substitutes" are sometimes prepared in which there is a large quantity of such liquids. All of the above operations involving the use of considerable quantities of volatile material, possibly storage as well, should be done outside of the paint factory, and are so treated in a good establishment. No heating process whatever should be conducted in a paint factory, such as boiling linseed oil.

Machinery. The machinery of the paint factory is all devoted to mixing and grinding. The first mixer, used to mix pigments and oil, is called a pug mill (Fig. 5). It consists of a vertical metal cylinder, closed

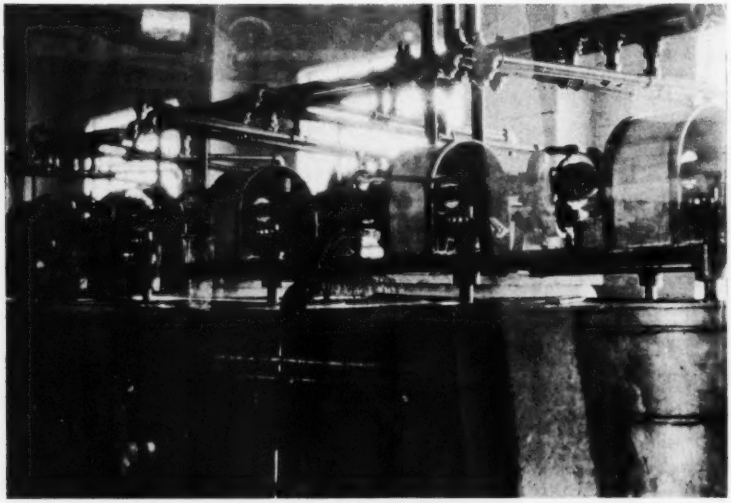


Fig. 6. Mixing Tanks

or open, fitted with a vertical shaft which rotates an arrangement of paddles. The last mixer in which the ground paste is thinned is the same as a pug mill only much larger and with a different arrangement of paddles designed to stir the mixture up from the bottom (Fig. 6).

The principal form of grinding mill, sometimes used to the exclusion of all others, is the horizontal buhr stone mill (Figs. 5 and 7). These mills are generally water cooled by means of a water jacket on the upper side of upper stone and lower side of lower stone, through which running water circulates. They are under-driven, the lower stone only revolving.

Cone mills, an enlarged form of the ordinary hand paint mills, consist of a hopper with a loose convex bottom rotated on its vertical axis. Grinding is effected by corrugations in the lower inside edge of the hopper and the corresponding outside edge of bottom. These mills are

out of date and are used only for coarse grinding, if at all. Steel mills, water cooled, somewhat similar in form to the cone mills but much better finished and with what appears to be a safer grinding action, are sometimes employed for grinding colors in japan.

Roller mills consisting of three rolls mounted in cascade form are seldom seen. Edge runners or "chasers" (Fig. 8) consist of a heavy wheel mounted on a horizontal axis or two wheels, one at each end of shaft, which travel slowly around a circular bed, giving a crushing and mixing effect to material placed in their path. They are sometimes used for

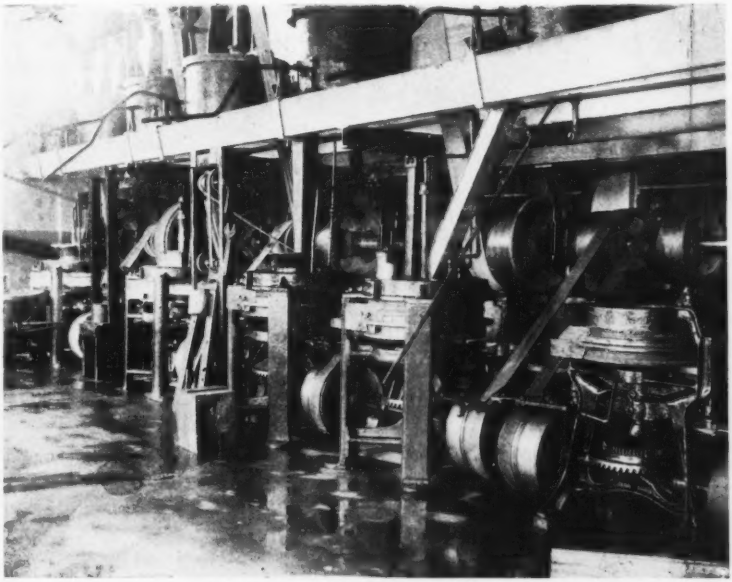


Fig. 7. Paint factory — Grinding.

incorporating a body pigment such as white lead with oil and are in universal use for making putty.

Paint machinery is all slow running. No machines operate over sixty revolutions per minute and some operate much slower; the high speed hazard does not exist.

Common Hazards.

The hazards of heat, light and power are very important, not only considered in the ordinary way but from the point of view of ignition of vapors. Heat may also effect spontaneous ignition. It is obvious that only steam or hot-water heating and electric lighting should be allowed.

The standard for lighting in places subject to combustible vapors should be enforced. The lights should be placed as high up as possible

without long lengths of cord; every lamp should be protected by a vapor-proof bulb and a wire guard; and especially no light should be installed over a mixing tank or other place where vapors may possibly exist. A direct current motor which is always more or less subject to sparking, especially if unenclosed and set on the floor, is a hazard outside of any electrical defects. The induction type is the only proper form. In lieu of this the motor should be placed on a shelf and carefully enclosed.

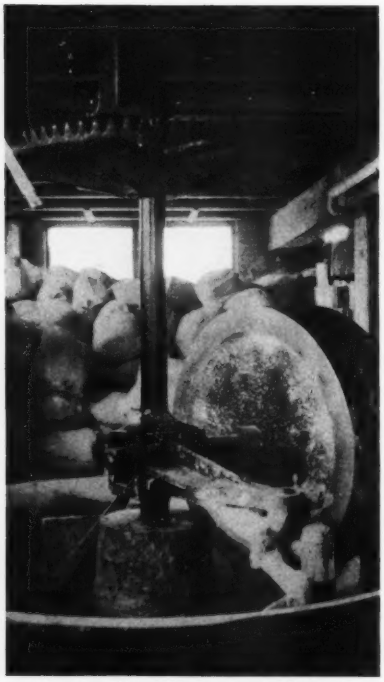


Fig. 8. Edge Runner or "Chaser."

The boiler house whether for heat only or heat and power, if not detached should be absolutely cut off from the paint factory with no door opening to main factory. The admonition that steam pipes must not run behind benches or be otherwise concealed, often not carried out in other factories, should be absolutely enforced in paint factories. An oily rag that finds its way under a bench may be harmless with no steam pipes near, but is liable to give an account of itself with the steam pipe.

Special Hazards.

The special hazards are as follows, given in the order of their prominence: Spontaneous Ignition, Ignition of Vapors, Direct Hazards of Manufacturing (as Grinding, Mixing, Canning and Straining), and Laboratory.

Spontaneous Ignition of Liquids. This is due to the familiar presence of oily material which in paint factories will generally mean rags of any textile material which are necessary and must be used in considerable quantity, also packing material and rubbish which are not essential. "Oil" in this connection means any liquid used in a paint factory except benzine and alcohol and all paint products except such as contain no oil or turpentine,—as shellac varnish. Rags impregnated with benzine, however, would generally contain considerable paint or oil and thereby become liable to this hazard.

The spontaneous ignition of any liquid in a container, covered or uncovered, of any paint product or of benzine vapor or any other vapor found in a paint factory is an imaginary danger. While it is quite possible to make a mixture of a pigment and linseed oil that would be susceptible to spontaneous ignition when not scattered over rags, etc., the

ordinary ground paste, which may be left in containers or machines over night or Saturday to Monday, is not subject to spontaneous ignition, nor indeed is it easily ignited.

Standard waste cans should be required as a temporary receptacle for oily material, but the usefulness ends right there so far as paint factories are concerned. If not emptied at least every night, even a standard can is liable to prove a hazard, not a safeguard. A closet for employees' working clothes to insure perfect safety should conform to the following conditions: To be so arranged that spontaneous ignition of contents is improbable, and to be so constructed and located that if a fire occurs it will be confined to such contents and not endanger surrounding property.

Spontaneous Ignition of Dry Colors and Lampblack. An oily rag dropped into a barrel of color or between barrels, or a small amount of linseed oil carelessly introduced would satisfactorily explain many cases of so-called spontaneous ignition that have been reported in dry colors. Opportunities for either of these conditions are not wanting, especially when a large number of barrels is in close proximity to operations of paint making. Some colors besides lampblack are probably not safe from ignition when exposed to excessive heat, as mentioned, and it is not impossible for a spark in grinding to be unnoticed and packed away in a barrel, giving an account of itself later. But with proper conditions of storage and use, especially as regards contamination with linseed oil, the spontaneous ignition of painters' color, except occasional cases of lampblack, do no seem probable. Where lampblack is not too closely packed, kept free from contamination with oil (especially linseed), not subject to dampness nor exposed to excessive heat (as setting a barrel against hot steam pipes), cases of spontaneous ignition will be rare.

The identical colors seen in paint factories are found in many other places, but so far as is known, the spontaneous ignition hazard seems to be confined to paint factories. It is usual to find a considerable stock of dry colors in paint factories, much more than the daily or even weekly needs of the business require even where such pigments as are used in considerable quantity, such as white lead, zinc oxide, barytes, etc., are stored outside. It is evident that this large storage is undesirable. The stock is subject to all fires arising from other causes, and the larger the stock the more danger there is of "color fires" of the nature mentioned.

Paint Factory Floors. The constantly increasing layer of dried pigment and oil sometimes seen on paint factory floors is not very inflammable provided it contains little varnish. But a floor once in this condition cannot be kept clean of the daily drippings and spillings of oil and more inflammable liquids which will ignite easily and burn quickly. A chance fire will be of a flash nature beyond any "first aid" appliances, possibly beyond those of the fire brigade.

Ignition of Vapors. The atmosphere of a good paint factory is seldom in a dangerous condition. A supply system which does away with tanks and barrels of japan, varnish and turpentine (which last may be a much more volatile substitute), benzine brought in only as required and

used at once, and covered mixing tanks are desirable conditions, but not always found. Vapors may exist at times even under such conditions, especially in the vicinity of mixing tanks. Workmen will be careless. Machines may be cleaned with benzine not used from safety cans. Therefore in good as well as in poor factories it is essential to allow no opportunity for a light or spark, so far as can be foreseen.

Outside of the ordinary exposure hazard from boiler room there exists the danger of fumes from the factory becoming ignited at furnace fires. An absolutely cut-off boiler room in a plant with steam power can easily be arranged and with proper construction can also be followed where steam is used for heat only. Otherwise it must be remembered that instances of benzine fumes igniting at twenty feet are numerous, and that they have been known to ignite at forty feet, the latter, however, involving an amount of vapor hardly possible in even a fair sized factory. Also that a fire door which may be open is no safeguard against the hazard, possibly not if closed, with a vapor that hugs the floor. The same conditions apply to laboratories where gas flames may be found at any and all times and where ignition of fumes from the factory has been proved to be a fact and not a theory. Questions of convenience may prove a bar to an absolutely cut-off or detached laboratory. The best arrangement is where the laboratory forms a partial third story on a two-story paint factory, the building being of fire-resistive construction.

Manufacturing Hazards.

Grinding. In grinding with a buhr stone mill there is a tendency to heat, particularly in "hard" or close grinding, generally allayed in a satisfactory manner by water cooling. The danger is from the mill "running dry," caused by a stoppage of the feed or by a dull and worn condition of the grooves whereby the paste does not ooze out freely. In this case the mill will heat up quickly, perhaps beyond control of water cooling, a spark may be struck, or heat alone rise to a point sufficient for ignition. With adequate attendance for the number of mills employed the danger is not serious. Other mills for the purpose and manner in which they are used probably present no more danger than the stone mill, and an edge runner or chaser appears to have no hazard at all.

Mixing. A frictional hazard only applies to this process, and it would seem very remote except by some dislocation of machinery. A fire is said to have occurred in a mixing tank, though ignition of vapor from some outside source would be much more probable (in which case the tank would, of course, blaze up immediately), and could hardly be called a hazard of the machine.

Straining. A fire occurred in straining an enamel which was regarded by some as due to a spark from static (frictional) electricity. The process simply consists of running the material through a piece of wire netting or through a pan, the bottom of which is the same, possibly brass. There is a well-marked hazard in the coating machine used in oilcloth and linoleum factories, of electrical spark from spreading knife,

safeguarded by grounding the knife. Possibly those who see an intimate connection between the two processes may recommend grounding the pan.

Canning. The hazard of soldering the top of a can is due to the possible ignition of fumes through unsafe location of gas flame used to heat iron. While this may be so arranged that there appears but little hazard, an open light in a paint factory cannot be regarded with favor.

Laboratory. While operations are in a small scale performed by an operator who knows what he is about, there is, nevertheless, some danger of accidental fire. A small japan oven will be necessary for testing if a varnish and japan factory forms part of the establishment. The hazard of fumes from factory has been mentioned.

Liability to Total or Severe Loss. Where the factory is also a storehouse for all sorts of supplies, including liquids in barrels and ordinary tanks, and is besides a warehouse for manufactured products, the liability to total or severe loss is apparent. The remedy is to make the paint factory a paint factory, to detach or cut off the warehouse with its packing and possibly printing hazards, to remove all supplies except such as are required for daily conduct of business, and last but not least, to have a system of storage and use of oils, etc., which will reduce the chance of an uncontrolable oil fire to a minimum. It is self-evident also, with a factory on these lines, that the chances of any fire at all are greatly lessened.

Fire Protection. This should consist of sand pails and chemical extinguishers, both of which should be required. Water casks and pails are not desirable. The only form of water in small quantities of any use in an oil fire is that from a chemical extinguisher, which has not only been proved to have some effect but is available to extinguish a small blaze before it reaches an oil. Sand will put out an incipient paint fire and is besides useful in checking the flow of burning oil. Standpipe and hose are desirable, though effectiveness is lessened where oils are concerned by necessity of limiting size to such as an ordinary inexperienced man can handle; for if water is used, the larger the amount the better. Oil fires of the linseed class are more amenable to extinguishment by water than petroleum products, though difficult enough when once under way. Where the area is limited and action by the fire brigade is prompt, a paint factory fire can be subdued even under somewhat unfavorable conditions.

Sprinkler protection in a good factory should be effective. In a poor factory it may or may not be, depending upon where the fire happens to start and the conditions for quick spreading.

Construction. While the ideal form of construction for paint factories is fire-resistive, yet a satisfactory factory can be made with standard mill construction. It is very desirable to have floors shut off. The shut-off should be absolute, there being no belt holes, chutes, nor other openings allowed. In any form of construction the building should not be over three stories in height and preferably two stories with no basement. Floors under paint machinery, if of wood, should be covered with metal.

Horse Whips: Manufacturing Processes and Special Hazards.

By John W. Chapman (Member N. F. P. A.)

The statistics of manufactures compiled in the Thirteenth Census of the United States taken in 1910 show that there were at that time in this country fifty-seven establishments engaged in the manufacture of horse-whips, employing 1,946 wage earners. There was an invested capital of $3,900,000 and the total value of the product of these factories amounted to $3,949,000.

A majority of these whip shops are located in Westfield, Mass., which is known as the "Whip City." There were, according to this same Census report, twenty-nine factories located there employing 1,203 persons. These factories had an invested capital of $2,779,000 and the value of their product was $2,774,000.

The trade name and brief description of each of the principal types of whip made to-day are as follows:—

Drop Top. Rigid portion wood butt with rattan stock and cloth drop or lash.

Wood Butt. Wood butt with rattan stock.

Stock Java. One piece rattan reed center, built up with eight split tapering pieces of rattan around load or iron spike at handle.

Full Stocked Rawhide or Whalebone. Rawhide and rattan reed center or whalebone and rattan reed center around which the whip is built up as in the Stock Java. The portion which is rawhide, or whalebone, varies considerably, but is generally from one-half to seven-twelfths the length of the whip. The rattan is split at end, to which the rawhide or whalebone is glued or "grafted."

Through Rawhide or Whalebone. Rawhide or whalebone center extending the entire length of the whip, around which the whip is built up as in the Stock Java.

Coach Whip. Ornamental Holly Handle with buckskin lash.

STOCK USED—MANUFACTURING PROCESSES.

The stock used and the processes of manufacture vary materially in the different kinds and grades of whips, but this article will deal more especially with what is known in the trade as the "Stock Whip," as

Fig. 1. Rattan Stock Room.

this type is made in the largest quantities and the processes of its manufacture contain all the important special fire hazards of the other types. The processes of manufacture may be subdivided under the following general heads or departments:—

1st. **Stocking Department,** under which heading are included the manufacturing processes on the stock or body of the whip, and which fall principally in the woodworking class.

2d. **Waterproofing Department,** in which the whip, is treated to make it impervious to moisture.

3rd. **Drop Top and Lash Making Department.**

4th. **Platting Department,** in which the thread is braided on the whip.

5th. **Sizing Department,** in which the whip is wet and rolled to give it a uniform taper and size.

6th. **Filling Department,** in which the whip is dipped in liquid compound which fills the spaces between the threads and gives the whip a uniform surface.

7th. **Rubbing Varnish Department,** in which the whip is dipped in varnish.

8th. **Trimming and Mounting Department,** in which the whip is trimmed with the ornamental rings, snaps, etc.

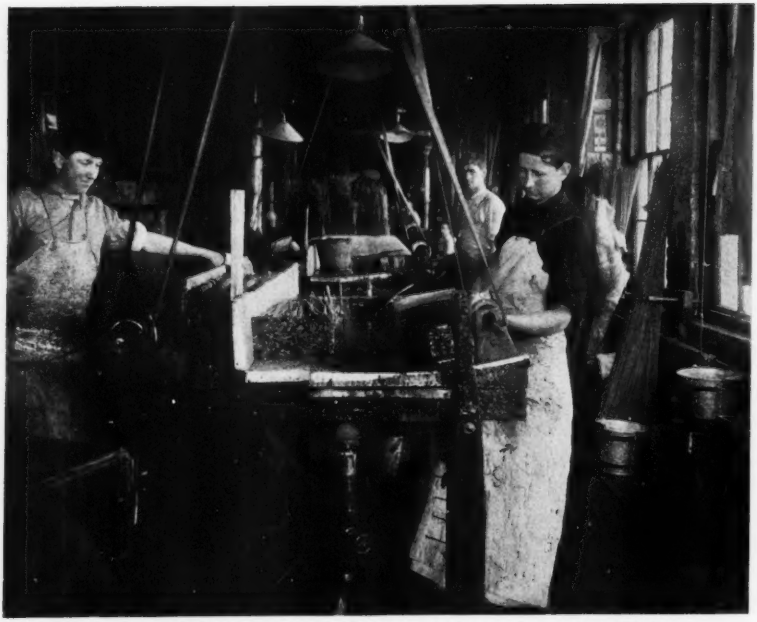


Fig. 2. Stocking and Glue Kettle Machine for Full Stock Whip.

Operator at right is winding on cotton thread. Operator at left is twisting rope around the recently glued whip. Steam heated glue tank in centre of machine.

9th. **Finishing Varnish Department,** in which the final coat of coach varnish is given.

10. **Storage, Packing and Shipping Department.**

STOCKING DEPARTMENT—STOCK.

Whip Butt Stock. May be any hard wood, but generally consists of beech, birch, maple or hickory. This is bought roughed out by the manufacturers and in lengths varying from twelve inches to eighteen inches with cross section about one square inch.

Loads or Spikes. Cast-iron plugs, solid or split, or wrought-iron tubes, located in the extreme butt end of the whip, used to make the whip balance properly.

Rattan. Bought in large bundles in lengths varying from twelve to sixteen feet. This stock comes in two forms, either with the bark or scale on or with this scale removed, in which form it is known as rattan reed. This stock is generally stored in basement or in detached sheds or storehouses in yard.

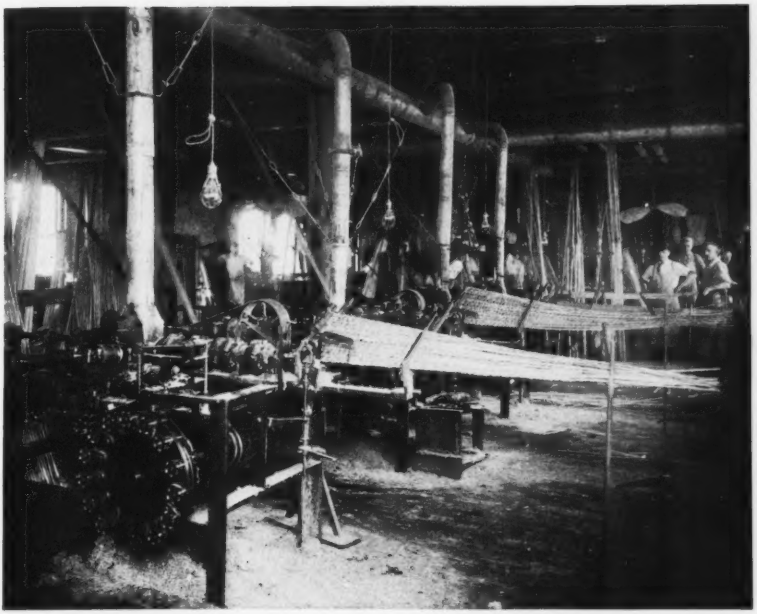


Fig. 3. Automatic Rounding Machine for Full Stock Whip.

Rack of machine shown full of whips with lower one just entering the cutter.

Rawhide Centers. These are made from Calcutta Buffalo hide, and at times from the hide of the manitee or sea cow, and generally come to the whip manufacturer in dried and twisted form, in varying lengths ready for use. Occasionally, however, these centers are manufactured at the whip shop as follows: The hides which have first been limed, unhaired and fleshed at the tannery are received at the whip shop in soft and pliable condition. These hides are cut in strips which are twisted on a special machine and while held in this twisted shape are dried slowly in steam-heated room. The centers are then removed from the dryer, cut to the proper lengths and ground (rounded) by holding against a rapidly revolving emery wheel, from which the fine dust is blown outside the building, the coarse dust falling into a bag under the machine. Dust and scrap are sold to glue manufacturers.

Whalebone. Used only in the most expensive whips and comes to the whip manufacturer in cut form of varying lengths ready for use.

Paper. A heavy brown wrapping paper is pasted and rolled around the cheaper grades of rattan wood butt whip where the rattan is grafted onto the wood butt to bring the whip up to size and make taper uniform and gradual.

Fig. 4. Turning Lathe for Wood Butt Whips.

Note large amount of shavings made in this process.

STOCKING DEPARTMENT PROCESSES OF MANUFACTURE

In ordinary work a full stocked whip is about three weeks in process. After the rattan has been sorted (Fig. 1), it is sawed into the proper lengths on an ordinary circular saw, and it then passes to the rattan whip-working machines, which are known as splitting, ribbing and shaving, grooving and chamfering or splicing machines. These machines are all wood-working machines, and their function is to bring the rattan into the proper form for building up the whip. The different pieces of rattan after passing through these machines are known as centers, wedges, siding and chinks. The rattan stock, which is now in the proper form for assembling into the whip, passes to the "stocking and glue kettle" machine (Fig. 2), on which the different pieces, after having all been immersed in a glue kettle which is a part of the machine, are assembled into the whip form in the following manner: Around the rattan or whalebone center, to which the load has been attached, are placed four rattan siding pieces which are tapering in shape and extend the entire length of the whip, and four rattan "chink" pieces which are tapering in shape and extend only a short distance, sixteen to eighteen inches, up from the

Fig. 5. Cloth Drop Top Cutting.

butt end of the whip. All the different parts are held in place as they pass through the machine by a cotton thread winding, after which the whip is passed to a second operator on the opposite side of the same machine who tightly binds the parts together by twisting a rope around the recently glued whip. The whips remain in the rope binder over night, or until the glue has properly set. The whip next passes to the automatic rounding machine (Fig. 3), which, as its name implies, automatically rounds and tapers the whip by feeding it through the machine against rapidly revolving cutters. It then passes to the tip grinder, on which machine the tip of the whip is pointed. This machine is the last through which the whip passes in the Stocking Department.

The Wood Butt Whip, which is a cheaper grade whip than the "stock whip" just described, is made by grafting (splitting and glueing) in winding machine a piece of rattan onto the wood butt. The whip is then ready for the turning lath (Fig. 4) on which it is rounded. It then passes to the papering machine which winds pasted paper over the joint where the rattan center and wood butt join to bring the whip body up to the proper size and taper. The wood butts are then chucked and bored and the cast-iron load glued into place.

Waterproofing.

After passing through the stocking processes the high grade whips are waterproofed. The practice of the different manufacturers in waterproofing the whip is widely different, but is generally accomplished in one of the following methods: By dipping about three-fourths of the length of the whip in a stock paint or in a white lead and linseed oil paint; by dipping the end in a hot paraffin solution; by encasing the whip in a sheet rubber covering previous to platting; or by placing and winding in position quillbone (the heavy part of the goose or turkey quill) so as to entirely surround and cover the slender portion of the whip.

Drop Top and Lash Making.

Drop top stock is cotton cloth, rubber-coated cloth, sheet rubber, sheep, calf and buckskin.

Several thicknesses of the stock which is to be used for the drop top are superimposed upon a bench and are then cut (Fig. 5) into the desired shape by an electrically driven vibrating knife. The top is then wound on and fastened to the rigid portion of the whip. The handle and top are all platted together.

The better grade of whip lash is made from buckskin and the cheaper grade is made from horsehide. The dried deer skins are received at the tannery, where they are soaked, fleshed and friezed (grain removed). They are then sent to the lash factory where they are tanned in a steam heated compound of potash, tallow, neatsfoot oil and water. The skins are immersed in the solution, where they remain over night, after which they are removed and hung up and dried by an air blower system at ordinary room temperature. This process is repeated several times until the skin is finally ready to be staked, which is done by stretching the skin between blunted steel blades. Horsehides which are to be used for whip lashes are tanned in a solution of alum and salt. The hides are then cut by hand in plats or strands of varying lengths dependent upon the length for lash to be made. The number of plats or strands in a lash varies in even numbers from four to sixteen and the length of the lash may be from three to twenty-four feet.

Platting.

After the whip has been stocked and waterproofed the next process in order is "platting" (Fig. 6), which is the name given to the machine which braids the cotton, linen, silk, or wire thread on the whip. The thread is bought on spools, from which it is wound onto the bobbins or small spools which are used upon the platting machines. In this process, as the whip is slowly fed in a vertical position through the machine, the thread is braided upon it by the quickly revolving bobbins.

Fig. 6. Platting or Braiding.

Whip is feeding vertically downward through centre of machine while thread is being braided upon it.

Sizing.

After platting the whip is wet, sized and rolled. In this process (Fig. 7) the whip is immersed in a dip tank filled with water and rolled under heavy pressure. The water softens the thread platting and the rolling brings the whip to a uniform and even surface. Whip is then dipped in another steam-heated tank which contains thin liquid animal glue and removed to steam-heated dry room. Dry room is run at low temperature and heated by horizontal steam coil located a few inches above the floor and covered by a heavy wire netting on which the whips are stood upright. After the whips are partially dry and in a tacky condition they are again passed through the rolling machine.

Filling.

After sizing and rolling, the whip is ready to receive a coating of filler. The purpose of this process is to fill all the small spaces between the threads of the platting covering, make a uniform surface and prepare the whip for the varnish coats. The filling process (Fig. 8) is the most hazardous in the manufacture of the whip on account of the nature of the stock used and method employed. Here appears for the first time the dip

Fig. 7. Sizing and Rolling.

tank hazard. The different manufacturers each use a slightly different formula for the filler composition and the exact proportions of the ingredients used are jealously guarded. They all, however, use the following materials in different proportions: Cornstarch (which is the base), boiled linseed oil, filler mixing varnish, paint, oil of shellac, dry paint colors and naphtha. The latter is bought by the manufacturers under the trade name of mineral turpentine. It is about sixty-two degrees test and comprises about thirty-three per cent of the total volume of the filler compound. The cheap paint used in the filler compound is especially prepared for this kind of work.

The filler dip tanks are built of sheet-iron, are seven or eight feet long, eight or ten inches deep, and eight or ten inches wide and stand on the floor or low platforms. When in use for dipping they are about one-quarter full of the filler composition. After dipping, the whips are placed upright against a rack immediately back of the dip tanks with the butt ends resting on a metal shelf which forms part of the dip tank. The superfluous filler is allowed to drain back into the tank. After draining, the whips are removed to another part of the room where they stand until they are dry. Whips are then rubbed with sisal or cactus fiber to remove the excess dry filler, after which they are rolled to make the

Fig. 8. Filling Room.

Dip tank and draining shelf at rear of room. The rubbing is noted at the left.

whip surface smooth and uniform. On high grade whips this filling and rolling process is repeated three times, after which the whip is ready for the first varnish coat.

Rubbing Varnish.

Varnish is applied to the whip by dipping in tanks (Fig. 9), which are similar in construction and shape to the filler dip tanks described under the previous heading. A cheap grade of varnish is used, which is thinned with turpentine. Special varnishes are prepared by the paint makers for this class of work, which are known as dipping rubbing varnishes, which can be bought with the different colors ground in or transparent, also light mixing varnishes, which are thinned with turpentine.

After dipping, draining and drying, the whips are rubbed with steel wool and rolled and the high grade whips are then polished with a compound of linseed oil and pumice stone, which is applied to the whip by gripping it with a saturated burlap pad while the whip is rapidly revolving in a chuck lathe. After this process the whips are cleaned by rubbing with cotton waste.

Fig. 9. Rubbing Varnish Room.

Note the large cans containing quantities of inflammable varnishes and the floor which is heavily coated with this material.

Trimming and Mounting.

After the rubbing varnish coats have been applied, rolled and rubbed down, the whip next passes to the trimming and mounting department, in which the mounts, buttons, ferrules, caps or heads, snaps and ornamental handles are attached.

The "mounts," which are the metal rings or ferrules with which the whip is ornamented, are nickel, silver or gold plated on brass or German silver and at times sheet-iron japanned. The manufacture of these mounts is a separate industry, and most of the whip shops buy them ready to apply to the whip. The "button" is the paper or thread ornamental ring or ferrule, and is generally made by each whip manufacturer. The process of making the button is as follows: Flour paste used cold and mixed in steam-heated kettles is applied to a sheet of cheap paper, the size of which is about ten inches square. The paper then passes through a ribbing machine, in which it is rolled on an arbor by a set of rollers which have cut on their surface the design which will be imprinted upon the finished button. This paper shell, after drying one day at ordinary temperature, is then coated with varnish, and after drying it is cut into

Fig. 10. Finish or Coach Varnish Room.

Dip tank for finishing coat of varnish at right. Whips hanging from racks to dry at rear. Bundles of whips after drying ready for finished stock room.

the proper button lengths. On high grade whips thread buttons are braided upon the whip by hand.

The butt end of the whip is protected with "caps" or "heads," which are either rubber, japanned metal or cast-iron loads. The manufacture of these "caps" or "heads" is also a separate industry not conducted by the whip manufacturers.

The mounts, buttons and caps are fastened to the whip by a pitch compound composed of resin and wax heated by gas flame in specially constructed stoves built of galvanized iron, which thoroughly enclose the flame and pot and have a thick coating of sand over the bottom to catch the drippings and to prevent the radiation of heat.

"Snaps" are made of cotton or silk thread and are braided by hand or machine. Preparatory to braiding the snap, the thread is drawn through a solution of harness makers' pitch, which contains a small amount of paraffin, heated by gas stove.

Ornamental handles are used on the most expensive whips. They are frequently of fancy leather, such as lizard, alligator or snake skin, and at times pearl and celluloid.

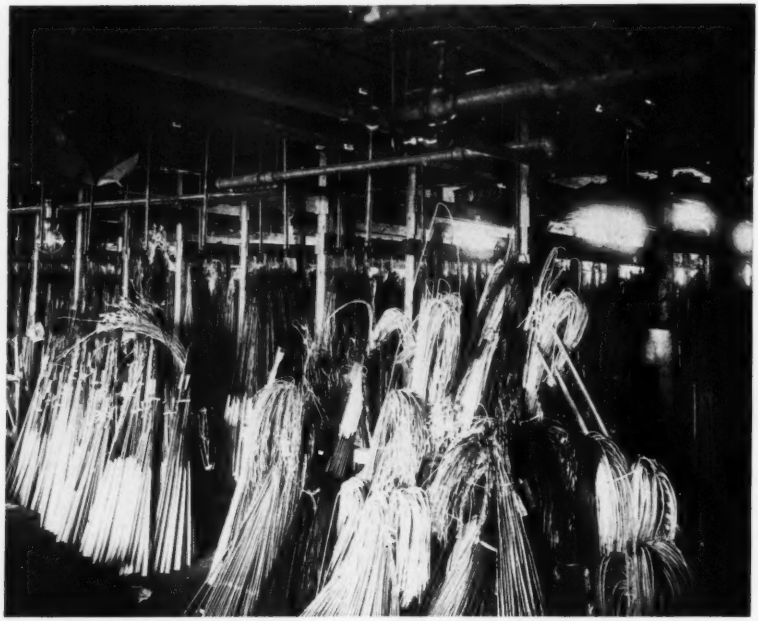


Fig. 11. Storage of Finished Goods.
Large value subject to one fire.

Finishing Varnish.

After trimming and mounting, the whips are taken to the finish or coach varnish room (Fig. 10), where they receive the finished coat of varnish. This may be applied by hand or in dip tanks. After varnishing, the whips are hung from racks until dry. In some factories a more modern method of drying is to place the whips after varnishing in an enclosure and subjecting them to circulation of air; then they are bundled and placed in the store room (Fig. 11), for finished goods, ready for packing and shipping.

SPECIAL HAZARDS.

Filling and Varnishing Hazard. The most serious hazard met with in the whip shop is the dip tank hazard which occurs in the filling and varnishing processes. In these processes the whip to be coated is dipped in the liquid filler, or varnish, instead of being coated by applying the liquid by a hand brush. Tanks of sheet iron are used and these are generally about a quarter filled with the liquid. The size of the tank varies somewhat, but is ordinarily about eight feet long by ten inches wide by

ten inches deep. The coating applied to the whip in the dipping process is not as uniform as a hand brush coat, but is considerably cheaper as large bunches of whips are coated at the same time, and the entire surface of several whips is covered with the filler or varnish by one dipping motion of the operator. Naphtha of sixty-two degrees test (known in the trade as "mineral turpentine") is commonly used as the thinner in the filling compounds and cheap grades of varnish used in whip shops, and frequently forms about thirty-three per cent of the volume of the mixture. As is well known, naphtha is volatile at ordinary temperatures, and any filler or varnish, where it is used as a thinner, partakes in a greater or less degrees of what is generally known as the naphtha or benzine hazard, and it is probable that the flash point of these mixtures may be at or below room temperature.

The last or finish coat of varnish which is applied to the whip is a much higher grade and is ordinarily thinned with turpentine or linseed oil for the better grades of whips, but in the cheaper grades naphtha is also here used as the thinning agent. Oil of turpentine has a lower flash and fire point than linseed oil, ignites more readily and burns more fiercely, but neither when unadulterated give off inflammable gases at ordinary temperatures. The hazard of the finish or coach varnish room is therefore slight, although the dip tank is frequently used in this department except in the very high grade of whips to which the finish coat of varnish is applied by hand brush.

Where it is desirable to complete an order quickly, the whip is sometimes finished with a coat of shellac thinned with wood or denatured alcohol. This coating is almost universally applied with a brush, is rather expensive and is only used on the better grades of whip. Wood or denatured alcohol which is used as the shellac solvent or thinner is very inflammable, but is not as hazardous as naphtha, owing to its higher flash point. The hazard in this process is not especially severe, as the coating is applied by hand brush and is used in comparatively small quantities.

In the article by H. A. Fiske appearing in Quarterly Bulletin No. 11, N. F. P. A., November, 1905, appear the following "Suggestions for Safeguards in Connection with the Dip Tank Hazard," Nos. 2 and 3 of which are quoted as an ideal arrangement, as they apply directly to the whip shop dip tank hazard:—

No. 2. If the dipping process is inside main building or adjoining buildings, the room in which the hazard exists should be on the bottom floor and should have special treatment. It should have a standard cut-off from the rest of plant by means of National Standard automatic fire doors. Floor should be incombustible, such as brick or cement; it should pitch to one side and have a drain pipe leading to underground well, drain pipe to be at least six inches and have a coarse strainer (say three-quarter inch mesh) at floor. Floor should be from four to six inches lower than the floors of adjoining rooms, or the threshholds should be raised that amount and partitions flashed so as to guard against inflammable liquids flowing to adjoining rooms. The pitched floor and drain are exceedingly valuable even if the floor is of wood. Tin covering for floor is not advised. Side walls of room, if of wood, should be protected by expanded metal and cement at least one inch thick. Partitions, constructed of iron studding and expanded metal and cement are

thoroughly suitable if kept in good repair. Ceiling should have similar protection. Room should be well ventilated by means of a ventilating flue with opening at bottom near floor. If artificial light is required, incandescent lamps should be used. Lamps should have keyless sockets and double glass globes and should not be located over the dip tanks. There should not be any switches or cut-outs in the room and it is often advisable to locate all switches and cut-outs on main switchboard. There should be as little inflammable material in the room as possible and room should not be used for storage of stock.

No. 3. For the tanks themselves, the following safeguards are recommended:—

a. Tank should be constructed in a substantial manner of iron or steel plate securely riveted together.

b. Each tank should have a wrought-iron overflow pipe leading outside of building to a well or cistern. These pipes to be at least three inches in diameter where the tanks hold less than 100 gallons and four to six inches in diameter for large tanks. Overflow to have a coarse strainer at tank. The well to which overflow pipe leads should be properly ventilated and should be at least four times the capacity of all tanks. Well should be at least fifteen feet from main buildings, and located on downhill side or so arranged that any overflow therefrom cannot endanger buildings.

NOTE.—The overflow need not be attached directly to the tank. One corner or part of side of tank may be cut away and a trough or gutter constructed which will discharge into the drain pipe.

c. Tanks should have automatic covers. A folding hinged cover is generally the most convenient, cover to be of metal or of wood covered with lock-jointed tin. Cover should overlap and be secured with strong metal hinges, the hinges being offset and protected against gumming. A fusible link with chain and counterbalanced weight makes a satisfactory arrangement.

In actual whip shop practice it is customary to carry on the dipping processes in a cut-off section of the plant. Occasionally the floors of this section are of fire-resistive reinforced concrete construction. In practice none of the dip tanks have an overflow pipe and none have an automatic cover. It is rather the exception for the dip tanks to have any cover at all. These are safeguards which are of questionable value in the eyes of the manufcturer and their use is claimed by him to be impracticable. The quantities of the dipping solution are not large and probably a maximum in any tank at one time would be fifteen gallons, with possibly four tanks in one room. Floors, benches, racks and walls where the filling is done become deeply coated with the filler compound. In order to save the expense of removing this coating from the floor it is quite a common practice to spread heavy wrapping or builder's paper upon the floor to catch the drippings and from time to time as occasion demands to clean the room by removing the coated paper.

The oils, paints and varnishes used in the filling room are generally bought in barrels or drums and stored in the first floor of a cut-off section in the upper floors of which the filling and varnishing processes are conducted. In this stock there are barrels of wood or denatured alcohol, black and orange shellac, raw and boiled linseed oil, oil of shellac, light mixing varnish, dipping rubbing varnish, coach varnish, paints and drums of naphtha or benzine (mineral turpentine).

The lampblack which is sometimes used to darken the filler should

be kept in a metal barrel or box. The main supply of oils, etc., if not stored in a detached oil house or cut-off section, should be stored in room built according to specifications of the National Fire Protection Association for inside oil rooms.

Main supply of naphtha should be in outside buried tank fitted with measuring pump located in dip tank room, all installed according to Rules of the N. F. P. A. Only small quantities of filler compound and the component oils out of which it is made should be allowed or kept in the filling room, and such material stored in this room should be in tightly covered metal cans. The drippings with which nearly everything in the room becomes coated in a comparatively short time should be frequently removed. Ample supply of standard waste cans should be provided for oily rags, waste and sisal fiber which are used to rub down and wipe off the surplus filler coats shortly after they have been applied and while they are in a tacky condition. As the filler contains linseed oil and turpentine the fiber and rags are liable to spontaneous ignition, and great care should be exercised in their disposition. Special care should be given to any refuse or material in this room, as it is very liable to be oil-soaked. Employees should have standard metal lockers for their clothing, and should never be permitted to throw oily material on floor under benches nor into corners. Large tanks of water in which the oily rags and fiber could be immersed after using would probably prevent some spontaneous ignition fires if tanks were properly cared for and rags removed daily. Inspection by the foreman before leaving the shop at night to see that all refuse and oily material have been properly disposed of is desirable.

A moderate supply of varnish must be kept in the room in which it is used so that it will be at a proper working temperature in order to obtain the best results. The best method to store and handle varnishes in quantities such as are used in whip shops would be to employ one of the patent air-tight storage tanks from which any quantity desired is pumped by hand. This system, however, is expensive, and some of the varnish makers claim, impracticable.

Woodworking Hazard. In addition to the essential hazard of the whip shop, as previously described, there is also the woodworking hazard involved in the turning lathe for wood butt whip and the automatic rounding machines for full stock whip.

These machines are provided with blower systems which are arranged in a manner usual to woodworking plants. The dust and shavings may be blown to a shavings vault or fed directly to the boilers. The shavings vault should be of standard construction, and the handling of the refuse in the boiler room should be according to the best approved practice, which has frequently been described in the QUARTERLY and need not be further discussed in this article.

It will be noted by consulting Fig. 3 that it is difficult to arrange the blowers at the turning lathes for wood butt whips to care for all the refuse, and the floor in the vicinity of these machines is apt to be badly littered. As noted in Fig. 2 the dust from the automatic rounding machines for

full stock whips is very well cared for. In these woodworking departments there should be floor sweeps or blowers so arranged that debris which collects on the floors may be quickly removed.

Fire Record.

The fire record of the whip industry covering the past six years is remarkable in spite of the seeming severity of the manufacturing hazards. The National Fire Protection Association has a record of only six fires, an abstract of each being given below:—

S-5970. Fire occurred in the boiler room of a sprinklered factory at 5.20 a. m. before the plant was in operation, from unknown cause, but probably in waste shavings. Some quantity of shavings was caked with turpentine, and it was thought that fire might have started in these. Two sprinklers operated and entirely extinguished the fire with practically no loss.

H-1723. Fire occurred in the finishing room of an unsprinklered factory at 5.45 p. m. after the plant had shut down for the day, from unknown cause. Fire was thought to have started in center of room near a pile of paper and nearly finished whips. About ten feet from this point there was an open varnish dip tank holding about fifteen gallons with turpentine substitute as a thinner. The last man left the premises at about 5.20 p. m. It was thought that an employee lighted his pipe or cigarette and failed to extinguish the match. Fire was discovered by an outsider. It was fought and extinguished by the public fire department. Loss on building $2,450; loss on contents $26,780.

H-1725. Fire was first discovered in the middle of the first floor of an unsprinklered factory at 3 a. m. by outsiders. Cause was entirely unknown. The loss was nearly total, the figures being as follows:—

Values:	Building	$12,242	Losses:	Building	$10,019
	Machinery	11,488		Machinery	9,604
	Stock	31,275		Stock	23,038

H-2447. Fire occurred in the boiler room of an unsprinklered factory at 8.47 p. m. and was discovered by an outsider. Fire was caused either by a back draft from the boiler or from the spontaneous ignition of refuse stored there for fuel. The refuse consisted of wood turnings, sweepings and about two tons of soft coal. The fire was fought and extinguished by the public fire department. Loss $6,000.

S-13402. Fire occurred in the filling room of a sprinklered factory at 4.15 p. m. It was first discovered by the employees, but alarm was transmitted to the fire department by the operation of sprinkler alarm and thermostats. This was a special hazard fire due to the process of filling. While the factory was in customary operation, in some way a dip tank of whip stock filler located on top floor became ignited. The exact cause of the fire was not clear. The filler which contained a large amount of gasolene was used in tanks such as have been previously described. At time of fire an employee had just taken a bunch of whips, dropped the butts to floor and was about to lay them on the bench when the contents of dip tank appeared to burst into flame. Workmen immediately brought eight hand chemical extinguishers into play and aided by three automatic sprinklers which operated for ten minutes under a pressure of ninety-five pounds, the fire was extinguished before the dip tank overflowed.

Fire may have been started by a spark which was struck when the loaded butts struck the concrete floor, or a match may have been on the floor and ignited by being struck or stepped upon.

The location of the sprinklers which opened with reference to the tank would indicate that there was a considerable draft of air in the room where fire started. This prevented the discharge of much water from sprinklers into tank and may have been a fortunate condition, as it is possible that much more damage would have resulted had the tank been overflowed.

A considerable water damage resulted on floors below.

H-8276. This fire occurred in an unsprinklered tenant whip manufacturing plant, in a portion devoted to the manufacture of whip buttons. There appeared to be some difference of opinion as to just how the fire started. It originated at a bench where black shellac cut with denatured alcohol was being used for shellacing whip trimmings. There were two small open dishes of shellac, holding about a half gallon each, on the bench, and a boy was applying this shellac with a brush to rolls of paper to be used as whip trimmings. After being coated with the shellac the rolls were stood on end to dry in racks directly back of employee. There was an open flame gas jet for light directly over bench and it was possible the shellac became ignited from this. It was also suggested that employee carelessly lighted a cigarette as he was about to leave, since the fire started within a few minutes before closing time.

The fire, once started, spead very rapidly, jumping to the drying racks and then to shelves filled with shellac-covered paper whip buttons and was quickly beyond the control of employees. Fire alarm was sent in from public box nearby and the prompt response of fire department and good work in fighting fire saved the building from total destruction.

Paper Box Manufacturing.

By J. Albert Robinson.

Forty years ago the only machines found in a paper box factory were the scorer, corner-cutter and the shearing machine. The bulk of the work of forming and finishing the box was done by hand. During the subsequent years closely following there was quite a development of automatic machinery, which has been developed and improved up to the present time. To-day it is a very small shop indeed that does not have most of the processes involved in the manufacture of pasteboard boxes automatically carried out.

The development of any great industry almost always carries with it a series of consequent lesser industries which are, however, quite necessary for the complete welfare of the former. An important example of this class of attendant industries is that of the so-called "paper box," "pasteboard box" or "cardboard box" manufactory. The great centers of the shoe industry, the hat shops, the knit hosiery and underwear factories, etc., all demand vast numbers of pasteboard boxes in which to ship the output of their plants. Box factories are, therefore, always found in such localities, and frequently these plants will also have their own box shops as part of their manufacturing equipment. Indeed, the demand for paper boxes is almost endless, and to-day large cartons and crates are replacing similar receptacles made of wood. The paper box industry is perhaps as widely disseminated as any important manufacturing business that can be mentioned.

According to the statistics of manufactures compiled from the Thirteenth Census of the United States, taken in 1910, there were 949 paper box manufacturing establishments in the country, with an invested capital of $35,000,000. The value of the yearly output was stated as $54,450,000. About 44,000 persons were employed in this industry.

There are three general classes of paper boxes. The so-called "folding" boxes are those which may be shipped in the folded or flattened condition. The "set-up" boxes are the ones most ordinarily found, and are shipped usually in the shape they have when in use. The shipping containers are boxes made either of a fiber board or of corrugated cardboard, and are rapidly replacing wooden boxes, or shooks, for the shipment of many materials, notably cereals and package goods of that nature.

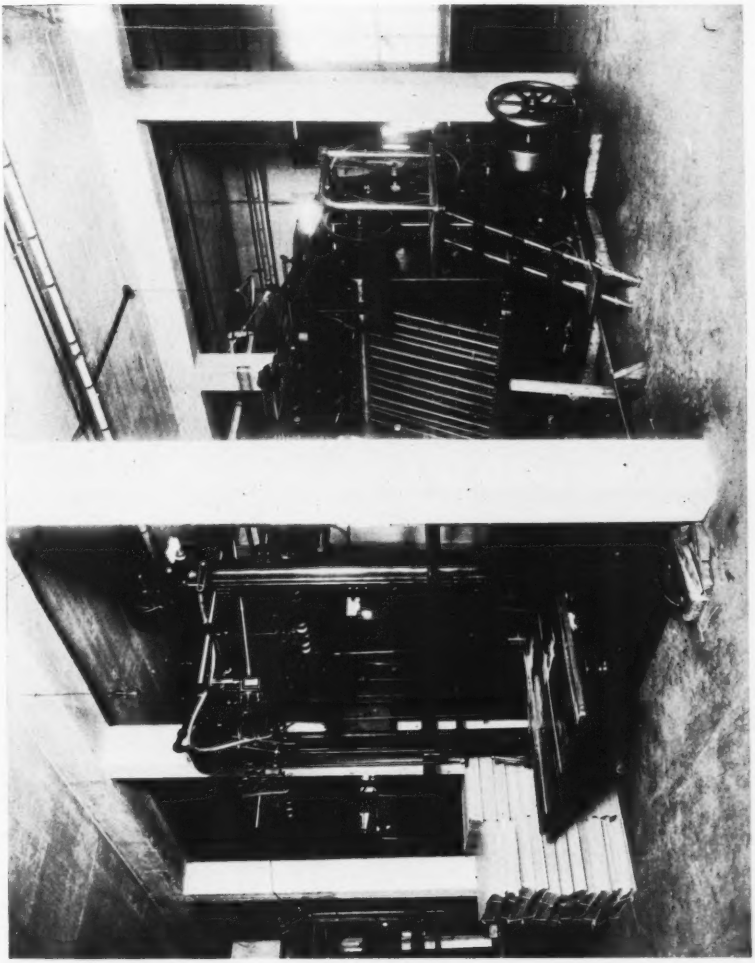


Fig. 1. Cutting and Scoring Press.

While practically every process employed in the manufacture of either one of the three boxes just mentioned is accomplished by means of some machine or other, and the number of machines in any plant whose business is at all considerable is therefore great, it is not a very difficult matter to get a working idea of the essential features of the principal machines to be found in operation in a typical factory.

In the case of plants making shipping containers the previous statement is not true, as this is a comparatively new business, and standard machines for making boxes of this kind are not yet on the market. The manufacturers design their own machinery, and most of them seriously object to the publication of any matter descriptive of the appliances they use.

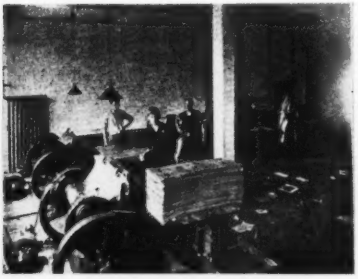


Fig. 2. Cutting and Creasing Presses.

Passing to the consideration of the machines employed in making boxes of the other two types, it is to be noted that practically the same procedure is followed in making boxes of both the set-up and the folding variety. Printing the cardboards or the paper cover, as the case may be, may be considered the first step of the process. A large percentage of the smaller boxes have to be printed on from one to four sides and in from one to three colors. Thus it happens that one finds in many of the larger plants a rather unusual assortment of high-class printing equipment.

What is really the first step in the actual making of the box itself consists in cutting the cardboard to the desired size, and scoring it in the lines along which the board must later be bent. There are two principal types of machines for performing this operation, one of which is shown in Fig. 1 and the other in Fig. 2. In machines of the first type the cardboard is placed on a moving horizontal table which carries it under revolving circular knives, and these latter do the necessary cutting and scoring. The other type of cutting and scoring machine is very similar to a printing press. The knives are set up in a form very much as type is arranged in printing, and the cardboard placed on this. The form then either passes under a revolving cylinder, or else the necessary pressure is applied as in the case of an ordinary job printing press. With either class of cutting and scoring machine, adjustable-speed drive is absolutely essential in order to secure the highest possible operating efficiency. Moreover, the greater the number of speeds possible—within reasonable limits of course—and the more readily the speed adjustment may be made, the higher the efficiency of operation. When the feed is automatic the best speed will depend upon the quality of the stock being cut and scored, while

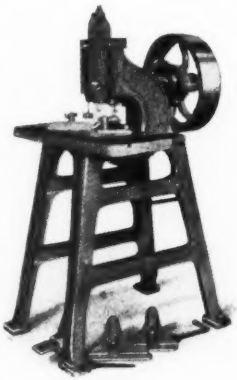


Fig. 3.
Corner Cutting Machine.

in the case of the hand-fed machine, the skill of the operator must also be taken into account in determining the proper speed.

After the cutting and scoring, the corners of the cardboard are cut away. Fig. 3 illustrates a machine generally used for this operation.

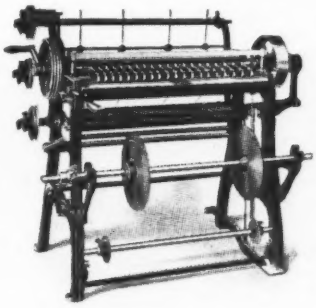


Fig. 4. Paper Slitting Machine.

The box next goes to the gluing or staying machine, which appliance brings the edges of the cardboard together where corners are to be made, and glues a narrow strip of paper or thin cloth over the corner along its length. This entire process is automatic, and here again adjustable-speed drive is essential to high efficiency of operation. If the speed of the machine be kept at the value adapted to gluing or staying small boxes of a good quality of cardboard, the spoilage is liable to be very great on a run of the larger boxes, or on those made of a lower grade of stock.

The slitter, shown in Fig. 4, is used for cutting into the proper widths the paper needed for staying corners and for covering boxes made of unfinished board. Fig. 5 is a covering and trimming machine for applying this paper to boxes of the class just mentioned. It will take different strips of paper and paste them on the under side, unite them, one overlapping the other, and fasten them on the box automatically at one operation.

Table gumming machines are frequently found. They are used to apply semi-liquid adhesives to the paper. The machine will gum and deliver upon the carrier work of all sizes, either small or large, from any width up to the width of the machine, and will apply the adhesive evenly in a thin coating without soiling the outer surface. The copper jacketed glue reservoir empties directly into the brass pot on the machine, and when hot glue is used, is equipped with a hot water heater heated by gas, which furnishes the hot water circulating system for heating the gumming materials in both the reservoir and pot. Fig. 6 shows such a system in operation.

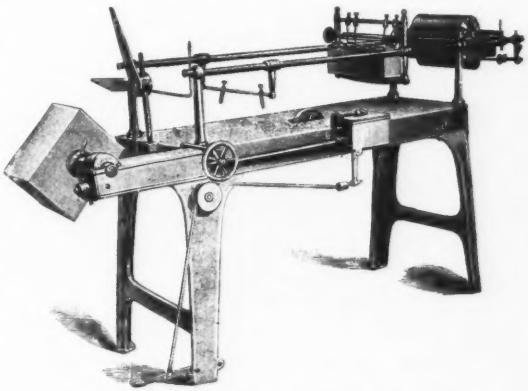


Fig. 5. Covering and Trimming Machine.

Fig. 6. Showing factory arrangement of a Perfection Gumming Machine.

Fig. 7 shows a room containing machines for stitching with metal rivets certain boxes where it is not desirable to glue the corners together. There are a number of other machines to be found in almost any box-making plant, but it was not thought necessary to include any others in this article.

The paste or gum is frequently prepared in the factory, and Fig. 8 shows a form of mixer and cooker. Glue is frequently used from small pots (Fig. 9) made to set in tables flush with the top, the steam or gas connections being underneath.

A characteristic of most paper box shops is the large amount of space which must of necessity be devoted to storage purposes. A fire that once gains headway in such locations is apt to result disastrously.

Fig. 7. Showing a Wire-stitching Room.

Hazards.

The principal hazard in the paper box shop is that of waste paper and cuttings. A number of operations, such as scoring, trimming, cutting corners, etc., simply eliminate pieces of paper or pasteboard from the raw material and add just so much to the waste pile. Care should be taken to see that the waste cardboard and paper do not come in contact with steam pipes. The waste should be carefully gathered up and baled

under pressure as fast as it accumulates and not allowed to remain in piles or bins where the presence of oily matter may induce spontaneous ignition, or where the careless disposal of matches or cigar butts may have an ever ready medium for action.

Fig. 8. Mixer and Cooker.

While cleanliness may be more or less desirable, from the manufacturer's point of view, in any sort of workshop, it is absolutely necessary that the paper box factory keep its products free of dirt, oil and dust. If the boxes are not turned out clean and fresh looking, there is little or no market for them. As a means to promote this end the individual electric motor drive for each machine is being strongly advocated in paper box factories.

Transmission of power by electricity is revolutionizing the methods of driving machinery in many industries. In box-making establishments the utility of individual motor drives on machines is most apparent in the economy of flexibility of speed adjustment, which is very essential in this industry.

Care should be taken to see that such equipments are installed in strict conformity to the National Electrical Code.

The glue pot offers the next particular source of hazard in the box shop. These may be heated by gas, steam or electricity. The modern electric glue heater is well adapted to box factory service, but most plants use gas and steam for heating glue. Some few use both electric and steam or gas heaters. In any case they are generally provided with a water jacket. Occasionally small kerosene oil stoves or gas stoves are used to heat the pots. The principal hazard in connection with these devices lies in allowing the heat to remain on after closing hours. By so doing the surrounding bench or material that may be left in contact with the heaters becomes ignited. The electric heater offers certain points of superiority over the other methods, in that there is no open flame present. It is very essential, where this type of heater is used, that pilot lights be provided on the electric circuit and that care be taken to see that the electric current does not remain on after closing. In many cases the heating of glue pots by electric current has not been satisfactory, and factories using them have in some cases replaced electric heating by steam or gas heating. The principal objections have been that the electric heaters have failed through burn-outs or similar troubles, and that too

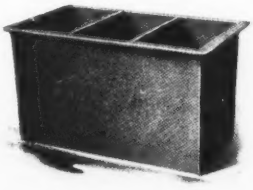


Fig. 9. Bench Glue Pot.

much time has been required to heat up in the morning, thus delaying the work.

There are a few miscellaneous hazards that are occasionally met with in the box shop. Where printing is done the usual hazards of this art are present, due principally to the presence of naphtha for cleaning, inky rags and paper, oily waste, etc. Some special gumming and varnishing require a naphtha-thinned material.

An important indirect hazard resides in the ready susceptibility of the stock and finished goods in box shops to serious water damage. All finished goods and piles of stock should be placed on skids. Factories should be provided with tarpaulins, and an organized salvage corps would be of distinct advantage. It would be desirable for plants equipped with automatic sprinklers to carry a form of insurance which indemnifies against loss from water occasioned by accident or defect, generally known as sprinkler leakage insurance.

Department of Fire Record.

By J. Albert Robinson, Superintendent.

The Paper Box and Papeterie Factory Fire Record.

One of the most noteworthy points one observes on reviewing the statistics in the fire record on Paper Box and Papeterie Factories is the fact that fires due to common causes outnumber those due to special hazard causes, practically three to one. The principal common hazard fires were due to lighting, rubbish and sweepings, and oily material. The principal special hazard fires were due to the presence of waste paper and glue pots.

A large loss resulted in seventy-four per cent of the fires which occurred in unsprinklered factories, but a large loss resulted in only sixteen per cent of the fires which occurred in sprinklered factories. No fire occurred in an unsprinklered factory in which there was no claim for insurance indemnity made, but in twenty-five per cent of the fires which occurred in sprinklered factories there was no claim made for insurance indemnity. Where the fire was practically or completely extinguished by the operation of the automatic sprinklers, twenty-nine per cent of these fires resulted in no claim for insurance indemnity and only 8.5 per cent of these fires resulted in a large loss.

There was only one fire in which the work of the automatic sprinklers was unsatisfactory. Of the remainder eighty per cent were extinguished or practically extinguished and twenty per cent were successfully held in check by the operation of the sprinklers.

Three-fourths of the fires were extinguished by the operation of three sprinklers or less, and in eighty per cent of the fires which were entirely extinguished by the sprinklers, three sprinklers or less were sufficient.

The average number of sprinklers opened, not including the one unsatisfactory case and one case where 400 sprinklers opened, was 4.5. The average number of sprinklers which opened in the cases where the fire was extinguished was 3.2, and an average of ten heads opened in the cases

where fire was held in check. In the cases where no claim for insurance indemnity resulted, the average number of heads which opened was 1.4; where small loss resulted, the average was 3.4; and where a large loss resulted, the average was 15.3 heads per fire. The average number of sprinklers which opened in wet systems was 3.9, while in dry systems the average was 6.4.

The average pressure in those cases where the fires were practically extinguished was about fifty-four pounds and those held in check forty-nine pounds. In the cases where no claim for insurance indemnity resulted, the average pressure was sixty-nine pounds; in those where the loss was small, forty-eight pounds; and forty-five pounds where the loss was large. The average pressure in the cases of wet systems was fifty-two pounds, and in dry systems the average was sixty-two pounds.

Paper Box and Papeterie Factories—Fire Record

Total Number of Fires, 103.

1. CLASSIFICATION OF CAUSES.

Summary.

Common Causes.

	No. of Fires.	Per Cent of Common Causes.	Per Cent of Known Causes.
Lighting	8	17.5	12.0
Boilers or Fuel	6	13.0	9.0
Power	3	6.5	4.5
Rubbish and Sweepings	8	17.5	12.0
Oily Material	8	17.5	12.0
Spontaneous Combustion (Miscellaneous)	1	2.0	1.5
Smoking	6	13.0	9.0
Matches	3	6.5	4.5
Sparks	2	4.5	3.0
Thawing Frozen Water Pipes	1	2.0	1.5
Total	46	100	

Special Hazard Causes.

	No. of Fires.	Per Cent of Special Hazards.	Per Cent of Known Causes.
Waste Paper	6	38	9.0
Glue Pots	3	19	4.5
Corrugating	1	6	1.5
Crimping	1	6	1.5
Drying	1	6	1.5
Papeterie Work	1	6	1.5
Printing	1	6	1.5
Spontaneous Ignition of Binding Twine	1	6	1.5
Varn'shing and Gumming	1	6	1.5
Total	16	99	
Common Causes	46		67.5
Special Hazard Causes	16		23.5
Incendiary	1		1.5
Exposure	5		7.5
Total Known Causes	68		100
Unknown Causes	35		
Total	103		

Details.

Common Hazards.

Lighting 8

Generally defective electric lighting system.

Crossed electric wires.

Open link fuse blew out on electric light system near stock of straw board.

A strip of cardboard was used for lighting gas, thrown upon the floor and supposed to have been extinguished. Smouldered until morning.

Employee left a candle burning on stack of paper boxes after stopping work.

Two girls lighted piece of paper to find their way out of room.

Watchman was filling his lantern just before starting his rounds and lantern exploded.

A meter was being installed. Gas escaped and was ignited by an open light.

Boiler 6
Sparks from stack lodged on shingle roofs 2
Metal flue from boiler to brick stack came in contact with combustible material.
Hot ashes from boiler rested against wooden sheathing of concrete wall.
Small pile of rubbish in front of boiler become ignited.
Spontaneous ignition in a pile of soft coal.
Power 3
Friction of rope drive on enclosing box.
Back firing of gasolene engine.
Loose wooden pulley became heated and ignited. Sparks fell into waste paper basket.
Rubbish and Sweepings 8
Spontaneous ignition of rubbish or sweepings in metal waste barrel.
Spontaneous ignition of rubbish or sweepings in wooden waste barrel.
Spontaneous ignition of rubbish or sweepings in elevator well.
Spontaneous ignition of rubbish or sweepings in basement.
Spontaneous ignition of rubbish or sweepings under shelves.
Spontaneous ignition in pile of rubbish or sweepings 3
Oily Material 8
Spontaneous ignition of oily waste 2
Spontaneous ignition of oily rags 2
Oily rags in contact with steam pipe 1
Workmen's oily clothing. Started in locker containing jumpers, etc., of machinist and millwright 1
Spontaneous ignition of oily waste or dirty accumulations around machines 2
Spontaneous ignition (Miscellaneous) 1
Spontaneous ignition in pile of burlap lying on floor.
Smoking 6
Employees smoking near lot of finished goods.
Boys smoking on platform set fire to waste paper in packing cases.
Boy smoking near waste paper crate.
Cigar thrown into waste box.
Carelessness in throwing cigar or cigarette butts away.
Cigarette stub or match thrown among loose waste paper on floor.
Matches 3
Careless use of matches by employees at noon hour.
Mice gnawing matches in drawer of one of the desks.
Rats and matches in baled stock.

Sparks 2
Sparks from passing locomotive.
Sparks from bonfire near plant.
Thawing Frozen Water Pipe 1

Special Hazards.

Waste Paper 6
Spontaneous ignition in waste paper bins or chutes.
Glue Pot 3
Gas glue pot heater ignited stock piled on bench.
Overheated gas fired glue pot.
Started at small gas stove used to heat glue pot.
Corrugating 1
Defective gas burner for heating machine.
Crimping 1
Crimping iron was overheated on small oil stove and when it touched the celluloid, the flames shot up to the ceiling. Edges of boxes were crimped with small sheets of celluloid.
Drying 1
Occurred in steam-heated dry box used for drying paper lunch boxes dipped in melted paraffin.
Papeterie Work 1
Small kerosene oil stove used to heat stock in process was filled with gasolene instead of kerosene, and it exploded.
Printing 1
Ignorant employee attempted to pour alcohol into a small blow torch while burning, which was used for repairing electros.
Spontaneous Combustion in Twine 1
Spontaneous ignition of bale of twine which was close to a steam pipe.
Varnishing and Gumming 1
Due to static electricity which ignited benzine vapors in varnishing and gumming machine.

2. MISCELLANEOUS STATISTICS.

Analysis of Losses.

Losses as Compared to Sprinklered and Unsprinklered.

	*Sprinklered.		Unsprinklered.		Total.	
	No. of Fires.	Per Cent of Sprinklered.	No. of Fires.	Per Cent of Unsprinklered.	No. of Fires.	Per Cent of Total.
No Claim	15	25	..	..	15	15
Small	36	59	10	26	46	46
Large	10	16	28	74	38	38
Total	61		38		99	

*Relation Between Effect of Sprinklers and Losses.

	Extinguished.		Held in Check.		Unsatisfactory.	
	No. of Fires.	Per Cent of Extinguished.	No. of Fires.	Per Cent of Held in Check.	No. of Fires.	Per Cent of Unsatisfactory.
No Claim	14	29.0	1	8.5	..	..
Small	30	62.5	6	50.0	..	..
Large	4	8.5	5	41.5	1	100
Total	48		12		1	

Losses as Compared to Causes.

All Causes.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent of Common.	No. of Fires.	Per Cent of Special.	No. of Fires.	Per Cent of Unknown.	No. of Fires.	Per Cent of Total.
No Claim	8	17.5	5	31	4	10.0	17	16.5
Small	25	54.5	8	50	15	36.5	48	46.5
Large	13	28.0	3	19	22	53.5	38	37.0
Total	46		16		41		103	

Common Causes.

	Sprinklered.		Unsprinklered.		Total.	
	No. of Fires.	Per Cent of Sprinklered	No. of Fires.	Per Cent of Unsprinklered.	No. of Fires.	Per Cent of Common.
No Claim	8	27.5	..	..	8	17.5
Small	19	65.5	6	35	25	54.5
Large	2	7.0	11	65	13	28.0
Total	29		17		46	

*Does not include four fires in which the heat was insufficient to operate the heads.

Special Hazard Causes.

	Sprinklered. No. of Fires.	Sprinklered. Per Cent of Sprinklered.	Unsprinklered. No. of Fires.	Unsprinklered. Per Cent of Unsprinklered.	Total. No. of Fires.	Total. Per Cent of Special.
No Claim..	5	38.5	..	..	5	31
Small	7	54.0	1	33	8	50
Large	1	7.5	2	67	3	19
Total....	13		3		16	

Unknown, Incendiary and Exposure.

	Sprinklered. No. of Fires.	Sprinklered. Per Cent of Sprinklered.	Unsprinklered. No. of Fires.	Unsprinklered. Per Cent of Unsprinklered.	Total. No. of Fires.	Total. Per Cent of Unknown
No Claim..	4	17	..	..	4	10.0
Small	11	48	4	22	15	36.5
Large	8	35	14	78	22	53.5
Total....	23		18		41	

Average Losses.

In the twenty-three cases of small losses where the loss figures were reported, among the fires which were extinguished by the operation of automatic sprinklers the average loss was $552. The minimum loss reported in these cases was $25, and the maximum loss was $1,160.

Amount of Water Used by Automatic Sprinklers.

In seventeen cases where the sprinklers extinguished the fire, the approximate amount of water used was reported. The average amount of water used was 1,440 gallons per fire, and the actual amounts varied from 100 to 4,000 gallons. Excluding the two largest amounts the average amount of water used per fire was less than 1,100 gallons, and excluding the three largest amounts the average was 900 gallons of water per fire.

3. ROOMS IN WHICH FIRE OCCURRED.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Baling	3	7.0	1	6	..	..	4	4.3
Basement	..	..	1	6	3	8.5	4	4.3
Boiler Room	1	2.5	..	..	2	5.5	3	3.2
Case Manufacturing	..	..	..	..	1	3.0	1	1.1
Chip Bin	..	..	..	..	1	3.0	1	1.1
Cutting, Trimming, Corrugating and Creping	1	2.5	1	6	..	..	2	2.1
Dust Room	..	..	..	..	1	3.0	1	1.1
Engine Room	1	2.5	..	..	1	3.0	2	2.1
Finishing Room	1	2.5	..	..	1	3.0	2	2.1
Hallway	..	..	..	..	1	3.0	1	1.1
Loading and Shipping Platform	2	4.5	..	..	..	..	2	2.1
Machine Shop	1	2.5	..	..	..	..	1	1.1
Manufact'g Room	9	21.0	6	38	7	20.0	22	23.2
Miscellaneous Floors. Specific occupancy not given.								
First	1	2.5	..	..	3	8.5	4	4.3
Second Floor	1	2.5	1	6	3	8.5	5	5.3
Third Floor	1	2.5	..	..	..	..	1	1.1
Fourth or Top	1	2.5	1	6	3	8.5	5	5.3
Office	1	2.5	..	..	..	..	1	1.1
Packing and Shipping Room	1	2.5	..	..	..	..	1	1.1
Printing Dep'tment	1	2.5	1	6	..	..	2	2.1
Roof	2	4.5	..	..	..	..	2	2.1
Rope Drive and Conveyor Tunnel	2	4.5	..	..	..	..	2	2.1
Stock or Storage Room	11	25.5	4	25	7	20.0	22	23.2
Toilet Room	1	2.5	..	..	..	..	1	1.1
Vacant Building	..	..	..	..	1	3.0	1	1.1
Waste Chute	1	2.5	..	..	..	..	1	1.1
Total with data given	43		16		35		94	
No data	3		..		6		9	
Total	46		16		41		103	

4. DAY OR NIGHT FIRES. (Day Fires 6 a. m. to 6 p. m.)

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Day	18	39	6	37.5	13	32	37	36
Night	28	61	10	62.5	28	68	66	64
Total	46		16		41		103	

5. PLANT IN OPERATION.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Plant in operation	14	30	6	37.5	8	20	28	27.5
Plant not in operation	32	70	10	62.5	31	80	73	72.5
Total with data given	46		16		39		101	
No data	..		..		2		2	
Total	46		16		41		103	

6. HOW DISCOVERED.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Employee	14	30	5	31.0	6	14.5	25	24
Watchman	6	13	4	25.0	6	14.5	16	16
Thermostat	2	4	2	12.5	1	2.5	5	5
Sprinkler Alarm	11	24	2	12.5	10	24.0	23	22
Outsider	13	28	2	12.5	18	44.0	33	32
Supervisory	..	..	1	7.0	..	...	1	1
Total	46		16		41		103	

SPRINKLER FIRE RECORD.

7. EFFECT OF SPRINKLERS.

	No. of Fires.	Per Cent of Whole.
Extinguished or practically extinguished fire	48	79
Held fire in check	12	19.5
Unsatisfactory	1	1.5
Total	61	
No claim	15	25
Small loss	36	59
Large loss	10	16
Total	61	
No sprinklers operated	4	

8. DETAILS OF UNSATISFACTORY SPRINKLER FIRES.

2609. Fire occurred in this factory at 1.40 a. m., October 27, 1903, resulting in practically a total loss. It was first seen by men on a switching engine about 300 feet to the rear who blew a recognized fire alarm, one long and four short whistles. This was at first not noticed, because they had been blowing just prior for the purpose of signaling. After the second or third time the watchman at hat factory nearby heard it and rushed out to find the north end of the box shop in flames. He started for the public box, but the flames had already attracted the attention of some one else who rang in a box nearby.

When firemen arrived six streams were put on from yard hydrants and neighboring public ones, two being from steamer. The fire now was rapidly spreading to middle and front of main building. At first the hat factory nearby appeared to be menaced and special attention was given this, as the roof caught several times. The wind carried the flames from here, but unfortunately blew them lengthwise of the burning factory. After three-quarters of an hour the fire was under control and the men were able to climb to each floor in front with a hose stream and thus stopped further advance of flames.

The lumber storage section at rear, the one and one-half story sawing and paper cutting sections and about one-quarter of main mill were destroyed. The roof inside throughout was badly charred; the ceiling of second floor throughout was considerably burned, but nearly two-thirds of first floor showed no evidence of fire except dampness, and sprinklers in that portion did not operate.

Construction. This factory was a three-story building of joisted construction with one-story addition on front end, also one and one-half story addition at rear, with shingled gabled roof, and adjoining this a one-story lumber storage shed, which also had some sheds adjoining it. Buildings were all above ground and the lower sections were poorly shut off from the three-story part by wood partitions which helped spreading of fire. Stairway was outside and an open hoist did not enter into spread of fire. Power was from hat factory adjoining and a wood box with belt within connected this building with hat factory. There was a condemned upright boiler in north end of three-story section near pulley box, and this had been used the Saturday before for burning paper cuttings and refuse, but the superintendent made a positive statement that this was not in use the day of the fire. The iron stack ran up through the two floors above to roof. Both of these floors were slatted as rooms above had been used for drying purposes when this building was formerly used as a hat factory. Some paper and cardboard were stored in these old dry rooms at time of fire.

Fire Protection. Sprinklers covered all portions of three-story section only. These were Grinnell metal disc heads installed in 1889, but many of them had since been replaced by the glass button pattern. Spacing was eight feet apart on line across joists by fifteen feet with joists between lines. Water pressure was seventy-five to eighty pounds from city waterworks. Second supply consisted of a 370-gallon steam pump. Street main was six inches with three public hydrants within 200 feet. Sprinkler connection to buildings was a four-inch only, which supplied both buildings, also two private hydrants. One of these hydrants, a two-way, was on the sprinkler connection to burned building.

Cause of Fire. Cause unknown. Its location undoubtedly was in unsprinklered lumber sawing and case making part, where it gained great headway because of the drafty conditions prevailing and combustible material probably lying around. Running up wall of three-story part adjoining, it was sucked up through slatted floors of old dry rooms and out into pulley box running to hat factory regardless of sprinklers. In fact one stream had to be directed in here throughout the fire. There was no evidence that sprinklers served to check fire. They were observed in operation by several men, and of approximately 120 heads all fused except those in front portion of first floor previously mentioned.

Conclusions. Serious unsprinklered portion was the primary cause of this destructive loss. Lack of standard alarm service was almost equally important. The desirability of large sprinkler connections where yard hydrants are connected was demonstrated. This fire emphasized how damage may result, where the sprinklers are helping to hold fire in check, if the pressure is suddenly reduced by taking off hose streams.

Summary: Unsprinklered portions and small sized sprinkler connections.

9. DETAILS OF LARGE LOSS SPRINKLER FIRES. (Where Sprinkler Control was Satisfactory.)

7527. Kilgour Brothers. Toronto Conflagration of April 19, 1904. This was a brick building of ordinary light construction, with unprotected steel and cast iron floor supports in part. The gravel composition roof first took fire. The fire then gained entrance through an unprotected doorway and window at driveway and through windows on upper floors where the city pressure was too low to supply the outside sprinklers. Building was equipped with Grinnell glass button sprinklers supplied by a 30,000-gallon gravity tank located sixteen feet above roof, which gave a static pressure of eighteen pounds on top line of sprinklers. The secondary supply consisted of low pressure water works supplied from a twelve-inch main through a six-inch connection. As the pressure was greatly reduced owing to the great demands made upon the system, this supply was of no importance in the service rendered by the sprinklers. There were about 750 heads in the building and 400 operated. They held the fire in check, practically saved the building from destruction, and stopped the spread of the conflagration.

10. POINTS OF INTEREST FROM FIRE REPORTS.

Electrical Conditions.

H-1637. Fire was thought to have been due to electrical defects. The conditions throughout plant had been reported as follows: Lamps were tapped directly from mains throughout, wires run promiscuously through and over walls and partitions with no protection, wires in contact with pipes, rods, paper boxes, etc., feeders everywhere overfused, cabinets in a useless condition, wire supports infrequent and poor, lamp receptacles defective and large lamps in positions liable to injury, unprotected by wire guards.

Strict adherence to the National Electrical Code is the only safe procedure.

Floor Openings.

H-4711. Poorly enclosed elevator wells were said to be largely responsible for the rapid spread of fire.

It is vitally necessary to shut off all floor openings in standard manner.

Open Sprinklers.

S-7034. During an exposure fire the open sprinklers were promptly put into operation by the watchman. They did excellent work in keeping flames out of the building, and none of the automatic sprinklers operated. However, two of the open sprinklers were found to be clogged and inoperative, and it was necessary to bring two hose streams and a number of chemical extinguishers into play to extinguish tbe flames which were gaining admission at these points.

This fire showed the need of frequent testing of outside sprinklers to insure reliable operation.

Shutting Off Water Prematurely.

S-9741. Watchman heard water trickling on the floor above. Believing that a sprinkler head had accidently released he hurried downstairs and shut off the water. He then rushed back and up to the top floor where he found a fire still in progress, so he went back and turned the water on again. Fire was eventually extinguished by the sprinklers, but the shutting off and subsequent turning on again of the water unnecessarily increased the water damage.

When sprinklers are discovered in operation the cause should always be definitely ascertained before the water is shut off.

Shipping Platforms.

S-13215. Fire occurred in waste paper stored on covered shipping platform and gained considerable headway.

Covered platforms should always be equipped with automatic sprinklers.

Skidded Stock.

S-12507. Fire occurred in basement where a large quantity of stock, very susceptible to water damage, was stored. Practically all this stock was on skids, and to this condition was attributed the fact that there was practically no water damage.

The practice of skidding stock susceptible to water damage should always be advocated.

11. NUMBER OF SPRINKLERS OPENED.

No. of Sprinklers Operating.	Extinguished Fire. No. of Fires.	Per Cent.	Held Fire in Check. No. of Fires.	Per Cent.	Unsatisfactory. No. of Fires.	Total. No. of Fires.	Per Cent.	No. of Sprinklers Operating.	No. of Fires.	Per Cent of Whole.
1	22	46	4	33.0	..	26	43.0	1	26	42.5
2	11	23	1	8.5	..	12	20.0	2 or less	38	62.0
3	5	11	2	16.5	..	7	11.5	3 or less	45	73.5
4	2	4	..	..	..	2	3.0	4 or less	47	77.0
5	3	6	..	..	..	3	5.0	5 or less	50	82.0
6 to 9 inc.	2	4	1	8.5	..	3	5.0	Less than 10	53	87.0
10 to 24 inc.	3	6	1	8.5	..	4	6.5	Less than 25	57	93.5
25 to 49 inc.	..	..	2	16.5	..	2	3.0	Less than 50	59	97.0
50 and over	..	..	1	8.5	1	2	3.0	50 and over	2	3.0
Total....	48		12		1	61			61	

Average number of sprinklers opened, not including unsatisfactory, and one case where 400 sprinklers opened, 4.5.

12. ALARM SERVICE.

Fires satisfactorily discovered by one agency alone. No failures reported.

Watchman.	Sprinkler Alarm	Thermostat.	Employee or Outsider.	Total.
8	12	4	8	32

Efficiency of Alarm Service Where More than one Agency was Used.

	Watchman.		Sprinkler Alarm.		Thermostat.		Supervisory.		Total.
	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	
Watchman and sprinkler Alarm	10	2	12	..	..	..	..	..	12
Watchman, Sprinkler Alarm and Supervisory	1	..	1	..	..	..	1	..	1
Sprinkler Alarm and Thermostats	..	..	2	..	2	..	..	..	2
Watchman, Sprinkler Alarm and Thermostats	1	..	1	..	1	..	..	..	1
Sprinkler Alarm and Supervisory System	..	..	1	..	..	..	1	..	1

Note.—These tables do not include fires where alarm service does or does not operate properly if fire is at once discovered by employee, the alarm service having no bearing on such fires one way or the other.

13. SECONDARY WATER SUPPLIES.

There were only three cases in which the secondary supply was reported as being a factor in the extinguishment of the fire.

12907. Primary supply consisted of a pressure tank which gave a static pressure of 100 pounds on the three sprinklers that operated. The second supply consisted of steamer connections which were used effectively. Sprinklers practically extinguished the fire.

13282. Primary supply consisted of low service waterworks which gave a static pressure of fifteen pounds on the twenty-one sprinklers that operated. The second supply consisted of a 12,000-gallon gravity tank, and this supply was said to have been a factor in the practical extinguishment of the fire by the automatic sprinklers.

5442. Primary supply consisted of a 2,960-gallon pressure tank which gave 100 pounds pressure at the dry valve. Five sprinklers operated and reduced the pressure fifteen pounds. About 300 gallons of water were used from the tank. Second supply consisted of a steam pump equipped with a Metz automatic regulator, which operated and supplied 900 gallons of water. Fire was entirely extinguished by the operation of the sprinklers.

14. EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Waterworks,	30	49.2	63	4.4	42.7	4.9	1.6	61	82	75	3.8	9.3
Gravity tank,	20	32.8	18	6.1	21.3	11.5	..	16	21	..	2.8	13.2
Pressure tank,	10	16.4	96	2.1	13.1	3.3	..	95	98	..	2.1	2.0
Automatic pump,	1	1.6	60	1.0	1.6	..	..	60	..	..	1.0	..
Total,	61	100.0	54	4.5	78.7	19.7	1.6	54	49	75	3.2	10.0

15. EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Less than 15 lbs.,	7	11.5	10.5	3.7	9.9	1.6	..	10.5	10.0	..	3.2	7.0
15 to 24 inclusive,	10	16.4	17.0	6.1	9.8	6.6	..	17.0	18.0	..	5.2	8.0
25 to 49 inclusive,	12	19.7	38.0	5.9	16.4	3.3	..	39.0	32.5	..	2.3	24.0
50 and over,	32	52.4	80.5	3.5	42.6	8.2	1.6	79.0	88.0	75	3.1	6.4
Total,	61	100.0	54.0	4.5	78.7	19.7	1.6	54.0	49.0	75	3.2	10.0

16. EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Wet system,	49	80.3	52	3.9	59.0	19.7	1.6	52	49	75	2.1	10.0
Dry system,	12	19.7	62	6.4	19.7	..	..	62	..	..	6.4	..
Total,	61	100.0	54	4.5	78.7	19.7	1.6	54	49	75	3.2	10.0

Note—"Average number of sprinklers opened" does not in any case include the Unsatisfactory fires.
One case, where 400 sprinklers opened and held the fire in check, was also omitted.

17. EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS —As Regards Amount of Loss.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Waterworks,	30	49.2	63	4.4	11.5	27.9	9.8	79	56.0	76	1.6	2.8	13.4
Gravity tank,	20	32.8	18	6.1	4.9	21.3	6.6	18	17.5	25	1.7	4.3	18.3
Pressure tank,	10	16.4	96	2.1	6.6	9.8	..	91	98.5	..	1.0	2.8	..
Automatic pump,	1	1.6	60	1.0	1.6	..	..	60	..	..	1.0	..	..
Total,	61	100.0	54	4.5	24.6	59.0	16.4	69	48.0	45.5	1.4	3.4	15.3

18. EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS —As Regards Amount of Loss.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Less than 15 lbs.,	7	11.5	10.5	3.7	3.3	6.6	1.6	9.5	11.0	10.0	2.0	3.8	7.0
15 to 24 inclusive,	10	16.4	17.0	6.1	..	13.1	3.3	..	17.0	17.5	..	6.8	1.0
25 to 49 inclusive,	12	19.7	38.0	5.9	3.3	13.1	3.3	40.0	38.5	32.5	1.5	2.0	26.0
50 and over,	32	52.4	80.5	3.5	18.0	26.2	8.2	85.0	80.5	69.0	1.3	2.3	15.5
Total,	61	100.0	54.0	4.5	24.6	59.0	16.4	69.0	48.0	45.5	1.4	3.4	15.3

19. EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS. —As Regards Amount of Loss.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Wet system,	49	80.3	52	3.9	21.3	47.5	11.5	67	46.5	43.0	1.3	3.0	16.8
Dry system,	12	19.7	62	6.4	3.3	11.5	4.9	80	61.0	52.0	2.0	5.0	12.5
Total,	61	100.0	54	4.5	24.6	59.0	16.4	69	48.0	45.5	1.4	3.4	15.3

Note—"Average number of sprinklers opened" does not in any case include the Unsatisfactory fires.
One case, where 400 sprinklers opened and held the fire in check, was also omitted.

GENERAL FIRE RECORD.

Unsatisfactory or Serious Fires in Buildings Equipped with Sprinklers.

Where sprinklers fail the cause is, almost invariably, clear. These fires are selected to indicate such causes, that they may be generally understood and satisfactorily met.

13573. Canadian Bag Company and Consumers Cordage Company, Montreal, Quebec.

Summary.

Fire started in or just outside of a frame building of very light construction and very large area, and was filled with material such as would spread a fire rapidly.

There was practically no water on the fire from any source for at least half an hour and the construction and occupancy of the buildings of both plants were such as to aid the spread of the fire.

Owing to the early collapse of the sprinkler tank, the sprinkler systems were without water during the time at which they could be of any value.

Construction and Protection.

Canadian Bag Company. Ninety per cent of this property consisted of wood, metal-clad construction, and ten per cent was of brick or brick veneer. A large part of the finish was hollow. The age of the buildings varied from ten to forty-seven years. Eighty-five per cent of the area was equipped with sprinklers, eighty per cent of which were Esty No. 6, and twenty per cent were Grinnell glass button. Eighty per cent of the system was wet and twenty per cent consisted of a dry-pipe system with a Grinnell differential dry-pipe valve. A small section of the equipment had been in for a good many years. Original heads were replaced by Esty sprinklers in 1903. Pipe sizes were mainly 1-2-4 schedule, but a part was installed according to the old 1-3-6 schedule. The equipment as a whole was considered fair.

Consumers Cordage Company. Fifty per cent of this property consisted of wood construction, part metal clad; thirty-five per cent was of brick construction and fifteen per cent brick veneer. The finish was hollow

in part. Most of the buildings in the main plant were from fifty-five to sixty-five years old. The warehouse No. 41 was nine years old and the stable was new. The rope walk was 1,100 feet long and forty feet wide. Forty-five per cent of the total area was equipped with Esty No. 5 sprinklers on a wet-pipe system. Most of the equipment was installed in 1899, but a small section had been an old Walworth equipment installed about 1888 but remodelled and heads replaced in 1899. The 1-2-4 pipe schedule was used. The sprinkler system, so far as it extended, was considered fair. The unsprinklered portions consisted of two-thirds of the rope walk, all of the

S-13573.

Machine shop of cordage company with collapsed tank trestle on left. Ruins of bag factory at rear. Ruins of portion of ropewalk in foreground, showing fallen sprinkler pipe. These sprinklers were shut off at time of fire.

warehouse buildings Nos. 35, 40 and 41, office and new stable. There were, however, about 200 sprinklers in the rope walk where it adjoined factory building No. 27. These were originally installed as a dry-pipe system, but had been shut off winters in recent years. As the rope walk was of light frame construction without any firm foundations extending below the frost line, it was found that the continual changes of level caused by the freezing and thawing made it impossible to maintain a dry-pipe sprinkler system.

Water Supplies.

There was a six-inch connection from a ten-inch city main and a four-inch connection from a four-inch main which supplied a six-inch yard main from which the sprinkler systems were fed. The normal static pressure from

the waterworks system was eighty pounds, which gave sixty pounds on the highest line of sprinklers in each factory. The second supply for each consisted of a single 15,000-gallon gravity tank on a forty-eight-foot steel trestle. The bottom of the tank was about eighteen feet above the highest line of sprinklers. The trestle was located near the machine shop and also the rope walk of the cordage company, and was unprotected.

Origin and Discovery of Fire.

It was not definitely established whether the fire originated inside of the rope walk or outside of this building. The testimony given at the official inquiry was conflicting on this point. The fire broke out Sunday evening, November 3, 1912. It was discovered by a boy resident in the neighborhood who sent in a box alarm at 8.12 p. m. A second alarm was sent in at 8.19 and a third alarm at 8.50 p. m.

Watchman's Failure.

The night watchman of the Consumers Cordage Company testified that he finished his first round on the Sunday night of fire at about 6.30 p. m., requiring some twenty-five minutes for this round including a trip through the rope walk. This was later verified from his records. He found everything in proper shape. His second round was concluded about 7.30 p. m., but on this round he did not go through the rope walk. He was in the office at the time of the fire but did not discover the fire.

He further testified that he had not been instructed to open the valve controlling the sprinklers in the rope walk, which were shut off in the winter, in case of fire. This statement was directly contrary to that of the machinist who had charge of the automatic sprinkler equipment for the Cordage Company, and who testified that all watchmen had been so instructed.

Cause of Fire.

The cause of the fire was not ascertained. There were gangs of young roughs, or hoodlums, in the neighborhood, and it was thought that the fire may have been of incendiary origin. In fact, several of the witnesses examined were under suspicion. The boy who sent in the first alarm had a mania for ringing in fire alarms to call out the department, but nothing could be proved to implicate anyone. It was stated that the rope walk had been cleaned up the Saturday before the fire, being in better shape than ordinarily during the week in this respect, so that there was nothing there to have caused spontaneous ignition.

Waterworks Failure.

Practically co-incident with the outbreak of the fire there occurred a break in the thirty-six-inch main in the waterworks pumping station, which necessitated the shutting down of the whole waterworks system.

From the data submitted by the waterworks officials, the particular Sunday on which the fire occurred was chosen as the day for putting in a new gate valve in preparation for connecting up a disabled pump (No 4).

S-13573.

Steel tank trestle after collapse.

S-13573.

Gravity tank after collapse. Photograph taken from base of trestle.

Another pump (No. 5), of twelve million gallons capacity, was shut down at 5.30 a. m. to start on the work. The work was completed about 7 p. m. and the necessary valves opened by 7.30 p. m. to start No. 5 pump again. This left two pumps out of five out of commission during the day. The pressure was taken every hour at the pumping station and the records from 7 a. m. to 7 p. m. showed that the pressure varied from sixty-two to seventy-two pounds. The normal pressure at the pumping station with the low level reservoir full was ninety pounds and it took eighty pounds pressure at the pumping station to have the water reach the reservoir. From the pressures recorded there was no water in the reservoir during the day and, therefore, no reserve to fall back on when the break occurred, necessitating the shutting down of all the waterworks pumps, except what water there may have been in the mains, the locality where the fire occurred being at a low level. There was no attempt made to concentrate in the vicinity of the fire what water there may have been in the mains.

The necessary repairs were not completed until 10 p. m. There was a memorandum to the effect that the pumps were started at 10 p. m. but no pressure was recorded at 11 p. m. A pressure of fifty pounds at the pumping station was recorded at midnight from pumps Nos. 1, 2, and 3. No pressure was recorded at 1 a. m. November 4th; fifty-eight pounds recorded at 2 a. m., and practically this pressure up to 7 a. m. The locality where the fire occurred is practically on the same level as the pumping station and approximately a mile distant.

The accident at the pumping station was stated to have been due probably to insufficient bracing of the temporary flanged end of the thirty-six inch main where disconnected from disabled pump No. 4. There was a rule at the waterworks to notify fire alarm headquarters of any water mains shut off, but no notice was sent of this particular break. The explanation offered was to the effect that before the proper waterworks officials were on the ground and the necessary valves closed to stop the flow of water through the broken main, it was thought that the condition of affairs would be self-evident.

How the Fire Was Fought.

On the first alarm one steamer responded as well as hose reels; on the second alarm three additional steamers responded. The steamer on the first alarm and the first steamer on the second alarm, as well as the hose reels, attached to the city hydrants, as is customary. The fire department did not have any previous notice of trouble with the city pressure aside from the fact that it was some fifteen pounds below normal, due to disabled pump No. 4, and a pressure of sixty-five to seventy pounds was to be expected. The two other steamers responding on the second alarm, coming from a greater distance were not so soon on the ground, and on arrival were sent to the canal, as well as steamers responding on the third alarm. The chief estimated a delay of half an hour from the discovery of the fire before any steamer was taking suction from the canal, and up to that time there were no effective hose streams on the fire, as it was stated that the city pressure was not even great enough to supply the steamers. The steamers

S-13573.

Standard automatic tin-clad fire door after fire, between Sections 27 and 28. (Door was closed during fire.)

S-13573.

End of Section No. 27, adjoining destroyed ropewalk, showing effect of fire on wired glass windows and tin-clad fire doors.

drawing from the canal, or flume fed by canal, furnished sixteen hose streams.

Failure of the Automatic Sprinkler System.

The sprinklers in the end of the rope walk adjoining factory building No. 27, of the Consumers Cordage Company, were shut off for the winter at the time of fire and were not turned on. Owing to the fierce heat from the burning rope walk the steel work of the sprinkler tank trestle became warped soon after the start of the fire and collapsed, throwing the tank into the rope walk. The tank was of limited capacity, viz., 15,000 gallons, and would have amounted to little as a supply to the sprinklers from such an exposure fire. Owing to the breakdown of the city waterworks, there was no city water supply available for the sprinklers for over two hours from the start of the fire. By the time any was available the broken sprinkler pipes and the large number of sprinklers opened would make this supply ineffective through the sprinkler system.

Fire Doors and Wired Glass Windows.

The fire doors between the rope walk and the factory building No. 27 adjoining evidently did good work, as they could be seen the night of the fire through the glare. The woodwork in same was practically destroyed and the iron frame supporting the doors (they were verticle sliding doors) was warped and the doors afterward collapsed.

Two of the three wired glass windows on the second floor of factory building No. 27 over the rope walk had the appearance of not having been closed at the time of the fire, although the statement was made that all doors and windows had been found closed previous to the fire. A pane of the wired glass in the third window rolled out of place, owing to the great heat.

Loss.

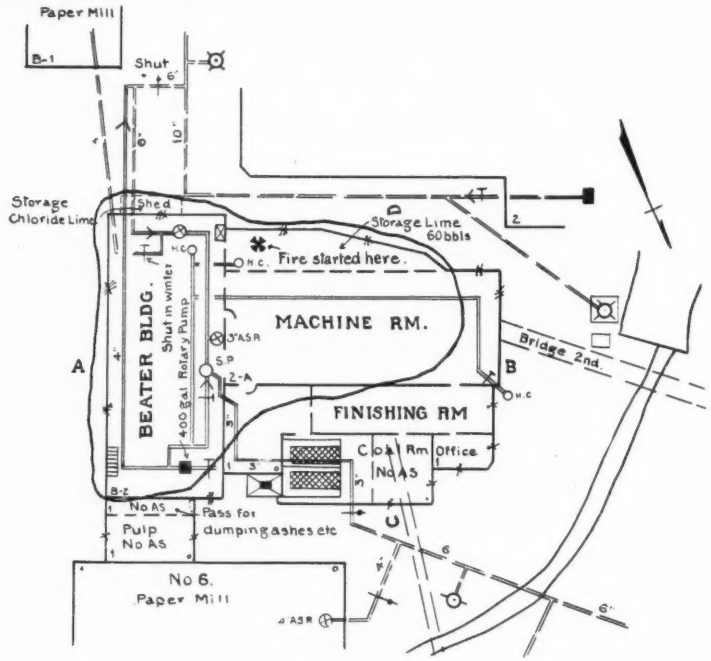
All the buildings of the bag factory were destroyed. The rope walk, warehouse and machine shop of the Cordage Company were destroyed, factory No. 27 badly damaged and factory No. 28 partially damaged. The loss amounted to several hundred thousand dollars.

This experience, with sprinklers shut off for the winter, together with experiences of a similar nature, show the futility of depending on human agency to open the sprinkler valves in case of fire where any portion of a sprinkler system is shut off during the cold weather. Such portions should be considered no better than an unsprinklered building or else they should be controlled by a dry pipe valve.

Summary: Water shut off in winter and crippled water supplies.

S-13615. Paper Mill. Construction and Protection. This paper mill was built of brick, with basement two stories and attic in part. Floors were plank and timber and the roof plank on wooden trusses. The finish was open throughout. Stairs were shut off, but there was an open elevator. The sprinkler equipment was not complete and there was none where fire started. Sprinklers consisted of Grinnell glass button, on wet system with 1-3-6 pipe sizes. The primary supply consisted of waterworks, 110 pounds

pressure, with a three-inch connection from a six-inch main. The secondary supply consisted of a 400-gallon rotary pump.



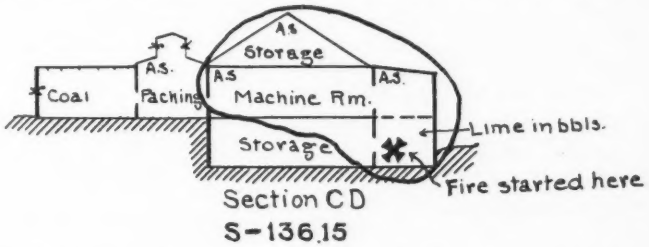
S-13615

Discovery and Cause. Fire was discovered by an employee about 7.30 a. m. Sunday, in the unsprinklered first story of the small addition south of the machine room. The fire was quite small at the time. Employee gave public alarm and aided in getting out a private hose. The room where fire occurred was not cut off and had been used for lime storage for some years. There was a protecting roof over the lime. There were probably over seventy-five barrels of lime here at the time of the fire. Owing to the occupancy, sprinklers had been omitted from this location.

Recently the owners had stored baled waste tissue paper in the east end of this room, which was supposed to be kept ten or fifteen feet from the lime. There was more of it on hand than usual. The fire started in this baled waste paper from some unknown cause, although its proximity to the lime may have caused the trouble. A pump was repaired here the day before and it is possible that some leaks might have caused water to reach the lime. Possibly the baled stock contained matches or oily waste. There were no electric wires near.

Story of the Fire. The fire department arrived promptly and put on two streams. The fire was quickly extinguished in the room where it

started and the owner and many others went home thinking that the fire was practically all out. Examination showed that there was not serious burning in this room. The firemen found that fire had passed up on a belt to the story above where some sprinklers had opened. There was some fire around a fan in a dormer window which was not well covered by a sprinkler. While bringing in a hose line to extinguish it there was a sudden collapse of the beater building, although no fire was seen there. The side walls above the second story at the southerly end fell with the heavy roof trusses, the latter pushing out the south end wall. Immediately after the collapse the ruins were quite generally on fire. Three pumps at nearby paper mills were started and furnished six good streams which were handled by the private brigades of the mills. There were about six more streams from the town water, so there was ample hose stream service.



The fire burned for some hours being finally extinguished before it reached the boiler house and without serious damage to the filter and the finishing rooms. The roof, attic and second floor of the beater building and over three-quarters of the roof of the machine room were destroyed. About half of the attic floor of the latter building fell on the paper machines. The south addition was undamaged.

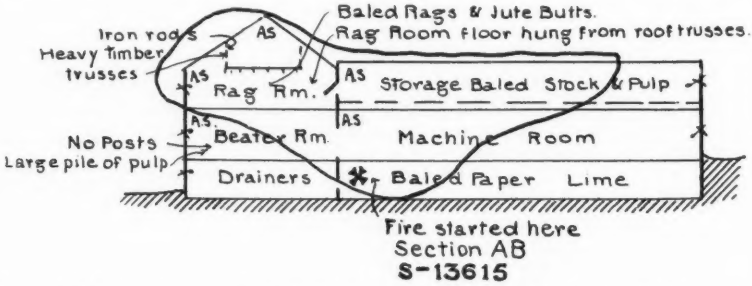
Action of the Sprinklers. The fire pump was not started. It was claimed that the thick smoke prevented its being reached, but evidently no attempt was made to operate the pump. The owner and the new mechanic assumed that the pumps of the other mills supplied the sprinklers as well as the hose streams, but they could not do so unless the post valve south of the beater building, normally kept shut, was opened. This valve was not opened nor thought of during the fire. As the factory pump was not started, the sprinklers were supplied only by town water through the three-inch connection from the six-inch main. As there were two hose streams off the yard hydrant on this six-inch pipe, little water reached the sprinklers. Testimony from several witnesses, however, showed that some water reached the sprinklers and that they practically held the fire on the second floor until the trusses fell, breaking the main trunk pipe.

The Explosion and Collapse. The reason for the collapse of the beater building was not very satisfactorily explained. The witnesses claimed that there was a hot air explosion which threw out the walls. Undoubtedly the buildings were full of dense smoke. It was stated by those who tried to enter the mill that the air inside was extremely hot, as might be expected

from the result of the slaking of the large quantity of lime, even if the fire was small. There was an open elevator in the south end of the beater building near the lime room which would conduct smoke and heat from the fire into the beater room. This elevator did not conduct fire, as it was not charred, nor were the fallen beams just above it.

It is possible that a hot air explosion caused the collapse, but a study of the wreckage indicated that it might have been caused by the overloading of the rag room floor.

This floor was hung by iron rods to the lower chord of the roof trusses. There was little weight in the attic, but the rag-room floor carried a stock of baled rags, jute butts, etc. There were no posts under this floor, the beams forming a single span across the mill with the one iron rod in the center hanging from the roof trusses. The latter were very



heavy timber trusses with bolted tie rods. The timbers were tied to the brick walls by lag bolts with large plates on the outside of the wall, so when they fell they pulled in this portion of the wall with them. The south end wall was pushed outward by the falling trusses and debris. This wall supported no important loads.

It is quite probable that the trusses had been loaded nearly to their safe limit, and when the large quantity of water was poured into this room and on the stock, which would retain much of it, the additional weight resulted in the collapse of a part of the wall. There were some old cracks in the river wall which indicated some such weakness previous to this fire.

Loss. If the beater building had not collapsed the loss would have been small. This collapse was not due to actual burning of the timbers. The sound value was about $60,000 and estimated loss about $50,000.

Conclusions. The owners were at fault in permitting the following conditions :—

1. Important areas not sprinklered. 2. Pumps not started and valve admitting water from neighboring pumps not opened at first alarm of fire. 3. Storage of lime inside building where apt to become wet. 4. Storage of paper stock in room used for lime storage and not equipped with sprinklers. 5. Heavy loads on floor hung from roof. 6. A three-inch pipe to supply all sprinklers.

Summary: Unsprinklered portions and collapse of building (hot air explosion or defective construction).

Fire-Resistive Buildings---Fire Record

These fires are selected to illustrate the behavior of various forms of fire-resistive construction under exposure to fire from within or without.

H-7782. Office Building. Construction. Built 1907. Twelve-story and basement building, T shaped, with a frontage of one hundred feet on West 32d Street and fifty feet on West 33d Street, with one-story and basement portions in both east and west angles and a seven-story and basement portion in the east angle; the whole of fireproof steel skeleton construction, Area 15,000 square feet. Walls brick, curtain, independent and party 24-12 inches; fronts (2) mostly plate glass between stone—faced piers 1st, 2d and 3d, brick to 11th, stone above; finish plastered direct. Parapets none on streets north and south, otherwise three feet. Partitions four-inch tile across building at about center of 1st, 3d, 4th and 5th and enclosing offices, mostly in 33d Street and on upper floors, also a few wooden office partitions mostly in 32d Street and on floors above 5th. Cornice metal. Skylights wired glass on metal frames on 1, 7 and 12-story portions, screened on 1-story portion. Floors single, seven-eighths inch pine on wood sleepers filled between with concrete on cinder concrete flat arches (thickness not ascertainable, apparently about four inches) on 10-inch 25-pound to 12-inch 40-pound steel I-beams five to six feet on centers, on 15-inch 42-pound to 20-inch 75-pound mostly twin steel I-girders sixteen feet on centers on steel columns built of plates and angles; four interior rows on 32d Street section, one row in center section and two rows in 33d Street end. Roof composition on arches and supports same as floors. Fireproofing beams and girders protected by arch construction on web and about one inch of plaster on wire lath on lower flanges. Columns imbedded in cinder concrete with minimum thickness of two inches on flanges. Ceilings plastered direct on floor arches.

Floor Openings. One double-car elevator shaft (used chiefly for freight) and an adjoining stair shaft on east side at 32d Street front. A single-car elevator shaft and an adjoining stair shaft at east side 33d Street front, and a bank of four elevators in one shaft with an adjoining stair shaft on west side at center of building, the latter rising from the main hallway on first which extends through from 32d to 33d Street. All shafts are of four-inch tile covered by skylights of wired glass in metal frames, but

slightly ventilated, and have kalamein doors with wired glass panels about eighteen by thirty inches. There is also a vent shaft of similar construction to other shafts in a portion of risk not affected by the fire. All stairs are of iron frames and webs under stone treads. The doors of the elevator shaft on 32d Street end (the one chiefly affected by the fire) were of the combination swinging and sliding type, hung by butt hinges to kalamein covered frames, the door construction covering the entire width of the shaft. In this shaft there were steel I members eight inches in depth spanning the shaft at each floor, which were not, however, part of the floor construction; these members were unproteeted.

Occupancy. Largely occupied by offices and stock rooms of printers and publishers.

Origin of the Fire. The fire originated from an unknown cause, apparently on the seventh floor near the 32d Street elevator shaft in a portion occupied for office purposes and storage of stock; this portion of the floor was considerably divided by wooden office partitions and fixtures containing inflammable stock. The space between the elevator shaft and the 32d Street front contained desks and typewriter tables, and the telephone desk was located in the recess formed by the shaft. Telephone company employees had been engaged during the previous day in making repairs and alterations in switchboard connections, a fact which may have some bearing on the origin of the fire.

Spread of the Fire. The direct damage from the flames was confined to the 32d Street end of the building on and above the seventh floor. The fire destroyed the elevator doors and ascended the shaft to the eighth and ninth floors, where the elevator doors failed completely and permitted its entrance to the equally inflammable material surrounding the shaft on these floors. The tenth floor being vacant offered nothing easily ignitible, and the elevator doors on this floor, while damaged somewhat, remained practically intact except the wired glass panels. On the eleventh floor the doors gave way sufficiently to permit the fire to enter and do considerable damage in the vicinity of the shafts, but several tile partitions which divided this portion of the loft held it in check somewhat, although the doors in the partitions were destroyed. On the twelfth floor a four-inch tile partition projected from the front of the shaft into the loft at a point between the two elevator doors. The elevator in the south side of this partition opened directly into the dining room of the Club occupying this floor, and the north elevator opened into a space containing the kitchen and steward's department. The fire practically destroyed both doors, but seemed to have found its way more readily into the kitchen section, where it consumed nearly everything combustible; such damage as occurred in the dining room being apparently due to intense heat radiation rather than to direct contact with flame. The varnished surface of the wood finish and other side wall decorations, which were of embossed paper, were badly scorched, likewise the covers and other linen on the tables.

While the kalamein fire doors with wired glass panels at elevator were defective in their construction and mounting, they were at a further disad-

vantage owing to the fact that the wired glass skylight at the top with insufficient vent proved stronger than the doors when the heat and pressure which accumulated inside the shaft found their way out on each floor rather than at the skylight at the top of the shaft.

How Fought. At the time the first alarm was sent in, the energies of the fire department were concentrated at a three-alarm fire already in progress. This seriously impeded the work of extinguishing this fire. There was also some delay in locating the fire in the building. The additional alarms sent in called into action twenty engine companies, five trucks and one water tower, the latter operating from the 32d Street front. Two of the standpipes in the building were utilized by the department in combating the fire, which was fought chiefly by the standpipes and water tower.

Damage. The damage to both the building and contents was confined almost entirely to the 32d Street portion and extended over approximately two-thirds of the area of each affected floor. The injury to the building was chiefly to the plastering and interior finish. The structural portion was unaffected, the protection of the steel work proving adequate to the requirements in this case. It is evident, however, that no extremely high temperatures were developed, since in other than very limited areas the fire did not get beyond a comparatively superficial stage or result in anything approaching complete combustion of even the most combustible material. Much of the contents, however, was especially susceptible to damage by both fire and water and the loss was heavy in most of the upper floors owing to the lack of properly waterproofed floors.

Conclusions.

1. All stair and elevator shafts should be ventilated by ordinary thin glass windows opening outside, or by thin glass skylight protected by wire netting; the skylight may have a wired glass top with thin glass sides.

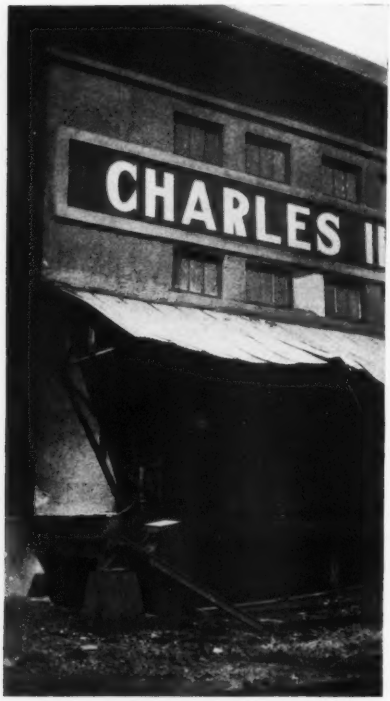
The above is quoted from the specifications for Skylights and Slow Burning Construction published by the National Board of Fire Underwriters. Its importance was strikingly illustrated in this fire, where the skylight was made of wired glass in a substantial metal frame and proved to be superior as a fire stop to the defective fire doors at each floor. The latter gave way under the heat and pressure developed inside the shaft while the skylight remained intact until finally broken open by members of the fire department to afford the much needed ventilation to draw the fire out at the top rather than permit it to force its way out at each floor.

2. The reliability of fire doors at stair and elevator shafts, fire walls or similar openings, is seriously impaired by the introduction of wired glass panels into their construction.

Owing to the fact that excessive temperatures beyond the melting point of glass are liable to occur in the interior of a building during a fire, wired glass should never be used where positive fire stops are essential, such as in connection with fire doors at fire walls and floor openings.

3. No kalamein or other type of fire door which has not successfully withstood a fire test for at least one hour at approximately 2,000 degrees Fahrenheit should be approved for use where fire doors are required in connection with insurance or municipal regulations. Moreover, no approved fire door should be mounted in a combustible frame.

The elevator doors which failed so decisively in this fire were substandard in nearly every essential feature of their construction and design and were improperly mounted in a wooden framing. Their failure on practically every floor was complete and quick; yet their superficial appearance would give the occupants a false sense of security. Unfortunately, the use of such so-called fire doors is quite general in New York City, although the additional cost of efficient doors is small when the importance of a reliable fire stop is taken into consideration.



H-8092.

4. Fireproof floors should be made more nearly waterproof and be scuppered or otherwise arranged to drain readily.

The damage in lower stories due to water seeping through the floor arches was excessive.

H-8092. Storehouse. Wholesale General Merchandise. This was a basement and two-story building of reinforced concrete construction throughout. All vertical openings were cut off and door openings protected by double labeled fire doors. Exterior window openings were protected by labeled wired glass windows and door openings were provided with Kinnear roller curtains. There was a wooden shipping platform along private railroad switch, with a corrugated iron covering. An empty box car took fire on this switch, and owing to a delay by the fire department burned fiercely and uncontrolled for some time. A strong wind blew the flames against the building. The heat was intense and the protective devices received a thorough test. All the windows were cracked and the steel curtain was considerably warped, but no flames entered. A fire broke out in the building, however, due to the ignition of wooden boxes which were stacked against the roller curtain

door. Most of the stock in this end of the building was placed on the concrete floor and a considerable damage occurred by water which accumulated in a large pool on the floor.

All stocks or combustible material should be kept a reasonable distance from exposed steel roller curtains or wired glass windows, as the radiated heat will ignite them.

Where a fire-resistive building is exposed by other burning buildings, even if the openings therein are protected, a close watch should be kept on the interior to prevent radiated heat from igniting combustible material contained therein.

Stocks of a damageable nature should never rest on the concrete floor itself, but should be raised a few inches on skids to allow a free passage of water.

Miscellaneous Fires.

Interesting fires are given under this heading without regard to their classification.

H-8128. Wholesale Grocery. Construction of Building. Main building (completely destroyed) was seven stories and basement, 80 by 160 feet, of brick, side walls each twenty-four inches first story, twenty inches the next two stories, and sixteen inches for the remainder. East side wall was independent full depth; west wall partly, except for about thirty feet at open space near center of building between adjoining buildings. Side walls parapetted average eighteen inches, stone coped.

Floors. Cement in basement; all upper floors of double thickness of one and seven-eighths inch matched pine, overlaid with seven-eighths inch matched maple with sheet asbestos under top layer.

Supports. Fifteen-inch longtitudinal steel "I" girders, and twelve-inch right angle "I" beams, former sixteen feet on center and latter five feet on center, these resting on cast-iron posts spaced sixteen feet on center both ways. Girders and cross beams were laid on cast-iron brackets on posts and bolted to cast-iron lugs on posts with two bolts through each lug. Ends of girders were set in bearing walls, being imbedded therein and not self-releasing. Size of cast-iron posts were, basement and first, ten by ten inches; second, nine by nine inches; third, eight by eight inches; fourth, seven by seven inches; fifth, six by six inches; and sixth and seventh, five by five inches.

Steel members were not fireproofed except in a section of first floor in east side, the posts there being enclosed in four-inch tiling, the girders and beams there being covered with metal lath and plaster.

H-8128.

Roof. Unprotected steel "I" girders and beams similar to floor supports on five by five-inch cast-iron posts; iron ties, twelve inches on centers, over beams supporting four-inch tile roof surface, overlaid with four-ply tarred felt.

Skylights. Two, eight feet by fourteen feet; six, nine feet by eighteen feet, metal frames and one-half inch ribbed glass. One copper ventilator.

Vertical Openings. Two open elevators, one at front and one at rear end, each opening containing two cars through all floors. Front shaft near all metal stairway through all floors. One dumb-waiter first to second in front end, also open.

Fire Protection.

Private. Full quota of approved fire extinguishers. One, one and one-half inch standpipe and hose system, 100 feet of one and one-half inch hose attached each floor except basement; water supply from street main, and 600-gallon pressure tank on seventh floor. City pressure at street about forty pounds.

Public. City service, five steamers within three minutes run.

Fire Alarm and Watch Service. Regular watchman employed for nights, Sundays and holidays, reporting to American District Telegraph Central station through "Bullock" boxes, full quota of stations. National Automatic Fire Alarm Service throughout building.

Origin and Spread of Fire. The cause of fire is not known, although watchman was in the building at time of discovery. The fire originated in rear end of first floor in receiving department, occurring shortly after six o'clock p. m. between shift of day and night watchman. A few minutes before discovery, the day watchman turned key over to night watchman, the latter then going to basement, later starting up small gas engine for elevator service (this being his custom), as he used the elevator in making hourly rounds through building. Watchman then started fire in boiler, a few minutes later hearing crackling of flames on floor above. He hurried to first floor, discovered fire, and claims to have pulled manual fire alarm box on first floor, the flames already having reached a point to require him to leave the building.

Central station signal service records show first alarm reached there at 6.12 p. m. from street box. This was immediately followed by box alarms in close vicinity of fire. At 6.22 p. m. a third alarm was received and at 7.16 p. m. a special alarm for four extra companies. The National Automatic Fire Alarm Central Office also received automatic fire alarm signal at 6.13 p. m., showing that automatic device operated slowly.

Apparatus at fire consisted of eighteen steamers and four three and one-half inch hose lines from high pressure service supplied by both fire boats, water pressure at boats registering 225 pounds and at hydrants 190 pounds. Water towers were not used.

Upon prompt arrival of fire department the flames had spread to all upper floors at rear of building, and within thirty-five minutes thereafter

H-8128.

the rear easterly wall and southerly wall bulged outward and fell. The ever-present unprotected vertical openings in connection with the combustible nature of contents therein, gave the flames immediate headway throughout the upper floors rendering the fire unmanageable. The unprotected steel and iron supporting members readily, under the heat strain became buckled and twisted, causing a collapse of upper floors and bulging outward of walls. The east and south walls gave way and fell outward. The west party wall, owing to resistance offered from adjoining building, withstood the pressure and remained standing. The entire building and contents therein represent practically a total loss, the rapidity of the complete destruction of a building of this type being marked by the fact that it withstood the flames no better than had the building been of light wood construction.

Loss. Practically total. The insurance loss on building was $100,000, on furniture and fixtures $17,500 and on contents the loss was $250,000.

Observations.

1. That buildings of this height and area with unprotected steel or iron supports and with unprotected vertical openings should not be permitted under any building ordinance or code. This combination of destructive elements presents every indication of a probable total loss by fire.

2. That buildings of this height and area, even though of standard construction having occupancies of this nature, should be equipped with sprinklers. This fire illustrates the inability of a modern fire department with modern equipment to cope with an extensive fire in a high building from the street grade so that interior accessibility to building for fire fighting is impracticable.

3. That this loss is but one of the many which have placed wholesale grocery properties throughout the country in a class well known to be of a destructive nature and carrying a high loss record.

13287. Jute Storehouse. A serious fire occurred in a one-story, brick building with plank and timber roof, used for the storage of hemp and jute. Fire was discovered at 11 25 a. m. and apparently originated near the base of the pile of bales. It burned its way very rapidly up the sides of bales in aisle down to center of building, burned across the top of bales and down in the three-inch space between the rows of bales (bales being piled up flatways), and attacked the plank roof and side windows of monitor at one or two points.

Twenty-six sprinklers opened and confined fire to a limited area at the point where it originated, and fire was extinguished with six hose streams of public department and two private hose streams. One thousand-gallon fire pump was operated about three-quarters of an hour when the 150,000-gallon reservoir became low, and as no water came in through six-inch filling pipe from city main, pump was then shut down. Sprinklers were

allowed to operate until about 1.30 p. m. when they were shut off by order of the fire department. At this time the 75,000-gallon gravity tank on one hundred-foot steel trestle was nearly empty. Static pressure on sprinklers was forty pounds.

It was evident that fire after being first discovered traveled rapidly up the piles of bales and over the tops for a short distance before the sprinklers operated. It was probably due to this quick flash fire that so many sprinklers were opened.

There were approximately 2,100 bales of jute, 250 bales of Russian and 275 bales of Italian hemp in warehouse at time of fire. A portion of these were more or less burned, especially on the ends, and a large number of bales badly wet down. This stock was skidded six inches. A number of bales of finished cord and about nineteen bales of burlap were also wet down. The cause of the fire was unknown.

The loss was very heavy, due mostly to water damage. Owners stated that three lengths of fire department hose burst in first floor of the warehouse for finished stock and thus caused considerable water loss here. This hose has been taken through this warehouse from the engines located on street in order to reach the seat of fire.

This fire emphasized the importance of leaving a clear space or aisle on all sides of baled jute or hemp and also the desirability of making storehouses for this class of stock as small as practicable in order to reduce the values in each fire area.

S-12997. Electric Railway Car Barn. This barn was of brick and concrete, two stories in height, and used mainly for storage purposes. Each level was divided into five sections holding forty double truck cars each.

Owing to the material used in the construction of this barn, it was considered that the wooden cars were the only probable source of fire, and aisle sprinklers only were installed. These lines were laid out in accord with the Underwriters' specifications, but the system was not completed. At time of fire the system was maintained wet and supplies consisted of waterworks and one 6,000-gallon pressure tank carrying seventy-five pounds air pressure.

The fire started inside of a large, double truck, closed car back of the sign lights, spreading to the vestibule and through the whole interior. When the windows broke out by the heat, ten sprinkler heads on three aisle lines opened. Aside from slight damage to surrounding cars by the first blast of heat when the windows went out, which blistered the varnish and cracked some windows, the fire was confined to the car in which it started. The work done by the sprinklers was perfect, and standing as the car did in the middle of the section, surrounded by forty cars of the same type, it will be seen that the sprinklers saved a very heavy loss. The estimated loss was $700.

H-8141. Restaurant. Fire is said to have started on first floor and to have been caused by a flash fire on the large gas griddle and broiler, which ignited the greasy vapors in the vent pipe of hood. The vent pipe (twenty-four by thirty-six inches) was made of light sheet metal and was

set in a metal casing in a wooden partition at back of griddle and passed through pantry—this section of pipe being about twenty-five feet long—to rear wall of building and was connected outside to main vent pipe. The hot vapors from griddle were drawn through this pipe by an electrically driven suction fan located where pipe passed through wall and thence to main vent pipe, which in turn was used for carrying off the vapors from the hood of a large coal range in sub-basement; main pipe was built outside of building from sidewalk to above roof and was fitted with additional suction fan above roof.

The suction fan on first floor apparently conveyed the fire at once to the main vent pipe. The first breakage in piping is thought to have been in the twenty-five-foot length on the first floor. The ends of this piping were poorly fitted, the defective riveting at the joints proving of little or no value. The fire apparently then made headway in this part of the floor and spread to floors above through wood dummy shafts and wood enclosed stairway; the flames reached toward the front of the building on upper floors, doing extensive damage, aided by a wood and glass light shaft above third floor in the center of the building.

Pipes constructed of light sheet metal are entirely inadequate to withstand grease fires which frequently occur in the ventilating systems of cooking ranges. The greasy vapors from all cooking appliances should be conveyed to flues or pipes constructed no less substantially than the brick flues or heavy iron stacks of steam boilers.

The condition of the wood enclosed and open shafts through the floors is another proof that this prevalent defect in building construction is largely responsible for the rapid spread of fires.

S-13585. Car Barn. Fire occurred in a large one-story brick car house with heavy plank and timber roof supported by wooden posts. Floor and pits were concrete. Building was divided by good fire walls into four main sections and an office, shop and stock room section which were also well cut off and sub-divided. Building was used for storage, repair and inspection of electric street cars. In the northwest section where fire occurred there were sixty cars stored, most of which were open summer cars. This section contained six tracks, all extending straight to street, there being ten cars on each track.

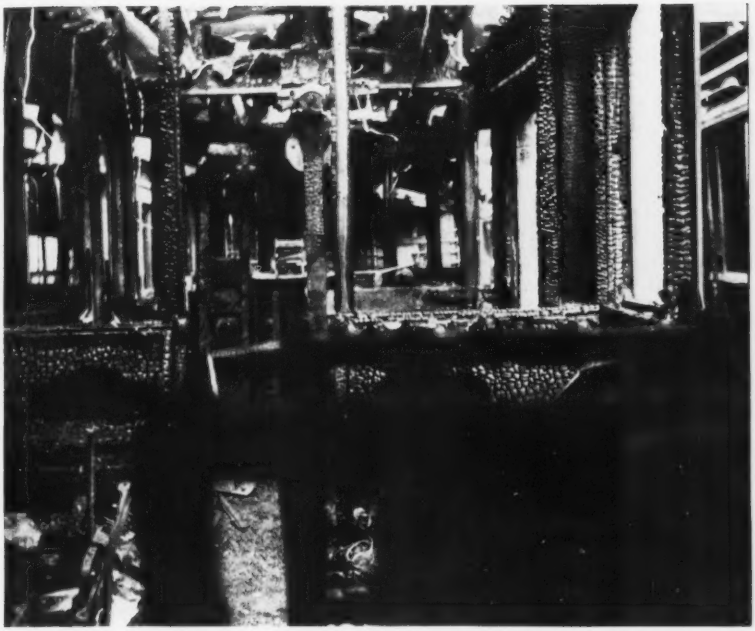
Protection. Building was protected by a standard ceiling sprinkler system, mostly dry pipe, Grinnell glass button heads supplied by city waterworks at forty-five pounds pressure. Pits were fireproof and not sprinklered. Secondary supply was a 1,000-gallon electrically driven centrifugal fire pump. Inside protection consisted of a good supply of two and one-half gallon chemical extinguishers. Alarm service furnished by electric bells connected to dry valves and by the "barn crew," generally consisting of five or more men. No regular watchman was maintained.

Cause and Extent of Fire. Fire was evidently caused by an electric heater located in the baggage compartment of a combination passenger baggage box car. The exact reason for the fire was not determined, but may

S-13585.

have been a defect in the heater. Floor of baggage compartment where fire started was wet, the result of transportation of several barrels of oysters. The trolley being reported to be off the wire all the time after car was stored, it is probable that fire was smouldering when car was brought in. The car body above the floor was badly damaged and will have to be entirely rebuilt. Slight damage was done to three open cars adjacent to the burning car.

Story of Fire. The car in which fire started had been in operation during the day and was put into the car house about 5.30 p. m. It was located on the second track from the outside wall of building and with all cars in was the sixth car from the front of the house. Employee who made his regular inspection of cars in the house at about 7 p. m. states that all trolleys were hooked down to tops of cars at that time. At about 2.10 a. m. employees in the building heard sprinkler alarm bells ringing and at about the same time the night foreman was informed by an outsider that there appeared to be a fire in the rear of the building. Employees immediately ran out the five cars on the track in front of the burning car and pulled public fire alarm box. Fire department responded quickly and extinguished the fire in about five minutes, using one hose stream and two chemical extinguishers. Twenty-nine sprinklers connected to two dry valves operated



S-13585.

and checked the spread of fire, but were unable to extinguish the fire inside the car, which was out of reach of water from sprinklers. The distance from car roof to ceiling of car house was about ten feet at this point. Fire had evidently been burning a long time and had gained considerable headway in the car before it broke out. Roof over baggage compartment was burned through and in passenger end shut off by a partition, the woodwork of roof was burned but canvas roof covering was not penetrated. Three open cars adjacent to the burning car were slightly damaged by scorching of curtains and blistering of paint. There was no damage to building. Value of car was not over $8,000. Estimated loss $1,200. Estimated loss on three cars adjacent $400.

Interesting Features and Conclusions. An interesting feature of this fire was the quick operation of dry valves and alarms and large number of heads opened with small resultant damage outside the car where fire originated. Heat was probably intense when fire broke out of car, opening many heads at once and allowing quick action of dry valves.

Prompt action of employees in removing cars from the barn was commendable. The tracks in this house were designed to facilitate the removal of cars in case of fire, and this was taken advantage of by the men on duty.

The probable effect of aisle line sprinklers in this case is worthy of

consideration. It was evident that fire had been burning for a long time and had gained considerable headway before it broke out of the car. Car was of monitor roof type. Baggage room had one ordinary sized window and a small window in door on each side. Action of sprinklers tends to show that a large amount of heat was suddenly liberated probably from both windows and roof. The fact that so little damage was done to adjacent cars showed conclusively that side windows had not been broken for any appreciable length of time before sprinklers operated. It would seem, in view of these facts, that at most the effect of aisle sprinklers would have been to somewhat reduce the damage to cars near the burning car, and possibly to have extinguished in part the fire in the car.

It is believed reasonable to assume that standard watchman's service would have resulted in quicker detection of the fire with consequent reduction of loss.

The fire pump was not started. All attention was given to the removal of cars, the result of which was to make a clear passageway to allow efficient work of the fire department. The fire was apparently well handled. It is suggested, however, that in all properties of this kind where water pressure from primary supply is rather light, it is desirable to have the crew instructed to start fire pump at once in case fire is discovered, in order that the additional pressure may be immediately available in case it is needed.

Fire Causes.

The fires here given are selected to illustrate defects, either of construction or superintendence, in the classes of property indicated.

S-13286. Arc Electric Light. Fire occurred in a portion of a tenant manufacturing building devoted to making men's suits. The enclosed arc electric lights were turned on and some hot ashes dropped onto a table covered with suits.

S-12689. Back Draft. Fire occurred in boiler house of a sash, door and blind factory, caused by back draft from furnace setting fire to pile of sawdust and shavings on floor.

Fuel should never be allowed to accumulate in front of the fire box of a boiler.

S-13197. Electric Currents. Fire occurred in a theatre, supposed to have been caused by telephone wires being accidentally charged with high tension current and becoming short circuited across a water pipe.

H-7777. Gas Light. Fire occurred in a stove works. A swing gas jet was located on a wooden partition and the cord of an electric drop light hung near it. The gas jet was accidently swung back so that flame ignited the cord and the partition was then ignited.

Gas jets should always be provided with wire bonnets to prevent the flame coming in contact with combustible material.

S-13010. Gasolene. Watchman in a metal worker was drawing gasolene by lantern light and gasolene was ignited.

It seems as if the insidious properties of the vapors from gasolene would never be recognized by many thoughtless persons.

H-8108. Gasolene Lighting System. An employee in a general store was attempting to light a gasolene lighting system having an inside carburetor, and in some way a fire resulted.

Gasolene gas machines having inside carburetors, are regarded as more dangerous than those having outside carburetors, owing to the fact that they introduce gasolene in liquid form and manufacture gas inside the building.

S-13216. Ignition of Awnings. Fire occurred on the awning of a tenant mercantile building, due to a lighted match, cigar or cigarette being thrown out of an upper window and lodging on the awning.

Fires of this nature are of frequent occurrence. It is entirely practical to treat the canvas so that it will become fire resistive.

S-13270. Locomotive Sparks. There was a small ditch beneath a wooden trestle of railroad track in lumber yard of a furniture factory. A spark from locomotive ignited some oil on the surface of water in the ditch. This blazed up, ignited the trestle and lumber piles and shed nearby.

S-13164. Loose Pulley. Fire occurred in a furniture factory, caused by a pulley which slipped on shafting and became overheated, setting fire to shavings and dust at conveyor fan.

H-8153. Matches. Fire originated in an agricultural warehouse by throwing a lighted match on an oil-soaked floor.

It is impossible to estimate the annual fire waste due to this simple act of carelessness.

S-13021. Oily Waste. Fire occurred in an auction house, due to the spontaneous ignition of a small quantity of oily waste used around elevator machinery.

Wherever oily waste is used, standard waste cans should be provided.

S-13162. Open Torch. Employee in working about the shafting in a paper mill ignited oily dust on the shafting by the careless use of his open touch.

Open torches offer a serious hazard, and their use should be discouraged.

H-7914. Outside Shut-Off on Gas Main. Fire occurred in a plant manufacturing an asbestos automobile brake, due to a leaky gas pipe on an unused baking furnace. Three meters were located inside of the building with no outside shut-off valve.

This fire demonstrated the need of convenient outside shut-off valves on all gas supplies.

S-12941. Producer System. Fire occurred in a metal worker caused by an explosion of gas in the water drain of a gas producer which became clogged up. The gas was ignited, owing to back pressure blowing out of suction pipe.

S-13288. Rubbish. Fire occurred in a coffee and spice factory, caused by the careless disposal of rubbish and sweepings. A porter was burning rubbish in a furnace in the basement. He left the locality. Some burning material dropped from the furnace onto the floor and ignited some rubbish lying near the furnace.

S-13200. Sun's Rays. Fire occurred in the machine shop of a leatherboard factory, caused, it was thought, by the focusing of the sun's rays on the dry window casing, due to some imperfection in the glass of a water bottle which was set on a shelf just outside the window.

S-13206. Workmen's Overalls. Fire occurred in a shoe factory, due to spontaneuos ignition of oily waste in the pocket of overalls hung in wooden clothes closet.

Overalls and workmen's clothes should either be hung on a non-combustible wall, or placed in a well ventilated metal clothes closet.

Points of Interest from Fire Reports.

These notes are intended to illustrate the efficiency or inefficiency of signaling, retardant or extinguishing agencies.

Alarm Service.

S-13004. Alarm Valve. Fire occurred in a tenant full process yarn and weave mill. An International variable pressure alarm valve failed to give the alarm because it was kept shut off on account of water hammer.

Proper installation will largely eliminate this difficulty. Alarm valves should be kept in service at all times.

S-13226. Alarm Valve. Fire occurred in an oil clothing factory which was provided with standard watchman's service. The watchman failed to discover the fire on his regular round. Alarm was given by the sprinkler alarm.

Sprinkler alarm valves are a very necessary adjunct to efficient watchman's service.

S-13445. Angle Alarm Valve. Fire occurred in a dry goods warehouse. The alarm valve consisted of a poor outside lever alarm. When sprinklers operated the valve kept reseating, thus sending intermittent rounds to central station, which confused and delayed the alarm at fire station.

Considerable trouble is experienced by these outside lever alarm valves. They should all be replaced with approved type of alarm valves.

H-7932. Watchman's Service. Fire was discovered in a wholesale paint and oil store by some outsiders after it had gained considerable headway.

Had there been a standard watchman's service maintained, fire would no doubt have been discovered in time to avert serious damage.

S-13295. Reason for Large Loss. Tenant twelve-story, fire-resistive manufacturing building. Fire occurred in eighth story and was extinguished by one sprinkler.

Large loss due to lack of watchman on that floor and failure of supervisory service.

Automatic Sprinklers.

S-13336. Dry System. Fire occurred in a flax and linen mill cold dry shed. The time necessary for the air to be discharged from the dry pipe system, which was of considerable length, permitted considerable heat to spread along the ceiling and twenty-four heads were opened.

It is doubtful if so many heads would have opened had water been on the system.

S-12928. Dry System. Fire occurred in a woodworking plant during cold weather. The dry system was crippled as a result of this fire by freezing up.

This incident emphasizes the necessity of quick action in draining a dry system that trips in winter.

S-13064. Failure. Fire occurred in the boiler house of a worsted mill, due to a defective brick flue which ignited roof. Water was shut off the sprinklers to prevent freezing.

Sprinkler systems subject to freezing temperatures should be provided with a dry valve.

S-11977. Failure. Fire occurred in the frame ventilator over hood of a paper machine in the machine room of a paper mill, from unknown cause. There were three sprinklers in the upper portion of this ventilator which should have properly extinguished the blaze, but the water was shut off the entire section on account of some repair work on the supply line.

Great vigilance should be maintained while any portion of a sprinkler system is out of commission. In making repairs, as small a portion as possible should be shut off. If the whole system must be shut off for any length of time, a man should be stationed at the main valve, and hose laid about the plant for emergency use.

S-12665. Heads Removed. Fire occurred in front part of basement of a tenant mercantile building occupied by storage of paper novelties. Fire was held in check by operation of twenty-four sprinklers and extinguished by the fire department. Fire gained considerable headway, owing to the fact that sprinklers directly over where fire started had been removed and outlets plugged, and sprinkler pipes were also installed too far below the ceiling.

The successful operation of automatic sprinklers, given ample supplies under suitable pressure, depends upon the careful manner in which the system has been installed and the integrity of its maintenance.

S-13011. Location of Valves. Fire occurred in a brush manufacturing plant during the evening and was quickly extinguished by the operation of one sprinkler. The gate valves were closed by a central station runner six minutes after the water flow signal was received.

Had the night watchman been thoroughly familiar with the location and operation of the gate valves, the water damage would not have been as great.

S-12958. Obstructions to Distribution. Fire occurred in a glove leather tannery under a deck of wide spaced slatted boards on which hides were piled. This offered considerable obstruction to the satisfactory distribution of water from the sprinklers.

It is preferable to place sprinklers under wide shelves, etc. The storage of material on them may render valueless the slatted construction, designed to afford water from the sprinklers above to pass through.

S-12903. Water Shut Off Too Soon. Fire occurred in a dry room in an oil-cloth factory. Sprinklers opened and probably had fire under control. Watchman heard water running and shut sprinkler valve. Instead of investigating cause, watchman continued his rounds and went to boiler house. Fire later discovered by an outsider. Sprinkler valve then opened and operation of sprinklers assisted in holding fire.

Many disastrous losses have occurred through similar carelessness. The cause of sprinkler operation should always be investigated before water is shut off.

Construction.

S-13430. Concealed Spaces. Fire occurred in the smithy of a wagon wheel factory, due to a spark which lodged in a broken place in the plastering, and the sprinklers proved unable to extinguish it.

Concealed spaces are always a detriment to the best results from automatic sprinkler protection. Where such conditions prevail, the sheathing or plastering should be kept perfectly tight.

8062. Cut Offs. Fire which occurred in one section of a storage warehouse spread to the next section which was situated at right angles to the first, in spite of good fire doors at door openings, because of the unprotected angle windows.

The protection of angle windows at fire sections is very important and frequently overlooked.

S-13283. Double Beam Construction. Fire occurred in a printing and bookbinding establishment having ceilings of the double beam construction with small space between. The fire worked into this space and the automatic sprinklers could not extinguish it.

This type of beam construction should never be allowed. Where now present, the crevice should be filled so that fire can not readily enter.

H-7672. Partition Walls for Large Areas. Building was five stories in height, 200 feet deep and twenty-seven feet wide, accessible only at ends. Fire fought at rear end from fire escape balconies and at front end

near which the fire started by high pressure streams from the street. Rear hose streams could not reach front end and streams from street directed through the windows above the third story penetrated the building only a short distance because of the angle of impact.

Fires at the center of narrow, deep buildings, inaccessible except at the ends, are of a type extremely difficult to extinguish. Skylights, which are usually found near the center of such buildings, add to the unfavorable conditions by allowing a premature vent for the fire at the most inaccessible point. Such buildings when not equipped with automatic sprinklers might be made somewhat safer by the introduction of a fireproof partition across the building near the center.

H-7846. Party Walls. Fire occurred in a theatre of brick construction and spread to an adjacent brick building because the roof timbers extended through the party wall between the two.

This is a common fault in city construction and frequently adds to the conflagration possibilities.

S-13448. Shingle Roofs. Fire occurred on roof of a storehouse at a sheepskin tannery, due to sparks from locomotive falling on shingled roof.

Shingled roofs are a constant menace and should be abolished.

S-13192. Unprotected Steel Members. Fire occurred in a fire brick and terra cotta works of brick and steel frame construction with exposed members and wooden floor and roof. All the bare steel structure was a bent and twisted mass after the fire and it pulled the walls so far out of plumb that they had to be rebuilt.

Unprotected steel construction has proved itself many times to be far inferior to average timber construction. Unless well protected in suitable manner to withstand the attack of fire, this type of construction invites disaster.

Floor Openings.

H-7672. Stairways. There was only one stairway in tenant manufacturing building, with ordinary wood doors with thin glass at the communication with each floor. The only other exit was by way of the outside fire escape at the opposite end, 200 feet distant, which would be made untenable by fire at any of the windows.

In every building two or more stairways, remotely located with respect to each other and enclosed in fireproof shafts, are essential for the escape of the occupants as well as for the work of the fire department.

H-7710. Elevator Shafts. Fire spread to all floors in a garage by way of open elevator shaft.

Elevators should be enclosed in brick or reinforced concrete shaft, walls to pierce all floors and extend at least three feet above roof. Approved automatic fire doors to be installed on one side of wall at all doorways to building.

Inside Protection.

H-8134. Chemical Extinguishers. A fire occurred in a lumber warehouse, and when first discovered by the watchman was of small extent, apparently in a pile of rubbish. As the nearest chemical extinguisher was more than a hundred feet away he went to the nearest street fire alarm box instead, and sent in an alarm. When the department arrived a serious fire was in progress.

Had there been a better distribution of chemical extinguishers or water pails, the fire might readily have been extinguished in its incipiency.

S-13509. Small Hose. Fire occurred in the mule carriage of a cotton mill. Had there been ample small hose and had those who discovered the fire made good use of same in the carriage, they could undoubtedly have extinguished the fire during the first few minutes. There was but one length of small hose, which was not sufficient to do the work before smoke made it impossible to remain in the room. Seventeen heads opened and considerable damage resulted.

Properly installed hand hose connections on sprinkler equipments in specially hazardous locations have proved very desirable and frequently prevent an undue water loss by extinguishing the fire before the automatic sprinklers operate.

S-13207. Steam Jets. Fire occurred in a carbonizing dryer in a shoddy mill. Dryer was equipped with steam jet inside and this was opened by the attendant when fire was discovered, but as the dryer was open at both ends this only served to drive the flames out at the ends.

H-7749. Steam Jet. Fire occurred in a Sargent Dryer at a full process woolen mill. It was successfully extinguished by a steam jet, consisting of a one-inch pipe placed about the middle of the inner side of steam coils at side of dryer. Jet was supplied by steam under eighty-five pounds pressure.

A number of fires have been successfully extinguished by this means. It is customary to stop the fans as soon as fire is noticed.

Protection Against Exposure.

H-7840. Unprotected Window Openings. Fire started in a one-story stuffing room addition to a brick harness factory. The numerous window openings and communications in the wall of main building readily admitted the fire to this building where most of the loss occurred.

The use of standard shutters and fire doors is one of the important adjuncts of good fire protection to-day.

H-7918. Protected Door and Window Openings. Fire occurred in the boiler room of a sheet metal worker. The two-inch non-standard, tin-clad, swinging door between seat of fire and main factory and the iron shutters at window openings on the exposed side effectively kept fire out of main plant, although the tin on the door had started at many of the joints and the wooden core was badly charred, and the shutters were badly warped.

S-13249. Protection of Basement Windows. Fire occurred several times in a tenant mercantile building, due to ignition of combustible material in basement ignited through open basement window by the careless disposal of lighted match or cigarette, etc., by passerby.

Basement windows should be provided with permanently located heavy screens to guard against this ever present hazard.

Miscellaneous.

S-13293. Standard Waste Cans. Fire occurred in the press room of a printery in a wooden box used for scrap paper and oily rags.

Fire very clearly indicated the necessity of confining all oily rags and waste in standard metal waste cans, for if they had been so kept in this case, the fire would in all probability have been confined to the metal can and would not have opened a sprinkler head.

S-12936. Ventilating Fans. Fire occurred in the garnett room of a shoddy mill. A ventilating fan which was in operation at the farther end of the room from seat of fire served to draw the fire to that end.

Ventilating fans should be stopped at once upon an alarm of fire.

Standard Rules and Requirements

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[SEAL.]

Fred'k J. Ranlett,
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